Specifications for

A New Apartment Community

at

Douglas Station

NW Sloan & NE Sycamore St.
Lee's Summit, Missouri
for
Douglas Station LLC

Architect

NSPJ Architects, P.A.
9415 Nall Ave., Suite 300
Prairie Village, Kansas

Structural Engineer

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Permit Set
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ARCHITECT OF RECORD

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Prairie Village, Kansas 66208

Architect of Record

09/02/2024
Date

END OF SECTION 000105.1

STRUCTURAL ENGINEER OF RECORD

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4338 Belleview Avenue
Kansas City, Missouri

Brandon Ford *08/30/2024*
Structural Engineer of Record *Date*

END OF SECTION 000105.3

SECTION 010005 CONTRACT DOCUMENTS

GENERAL

1.1 CONTRACT DOCUMENTS SHALL CONSIST OF THE FOLLOWING:

A. General Conditions.

B. Supplementary General Conditions.

C. Construction Documents.

1. Specifications - Division 01 through Division 33.

2. Construction Drawings: Reference Drawing Sheet A0.00 (Cover Sheet) for an Index of Drawings.

END OF SECTION 010005

SECTION 010010 GENERAL CONDITIONS

010010-1 The General Conditions of the Contract for the Construction of Buildings, American Institute of Architects, Standard Form No. A-201, latest edition, is hereby made part of this Specification and shall govern all divisions and sections of this Specification.

010010-2 Copies of the General Conditions, Standard Form No. A-201, are on file and may be examined in the office of the Architect, 9415 Nall Ave., Suite 300, Prairie Village, Kansas 66208.

END OF SECTION 010010

SECTION 010020 SUPPLEMENTARY GENERAL CONDITIONS

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10020-1 GENERAL CONDITIONS

The "General Conditions of the Contract for Construction", AIA Document A-201 are general in scope and may refer to conditions not encountered on the work covered by this Contract. Any provision of the said document which pertains to a nonexistent condition and not applicable to the work to be performed hereunder, or which conflicts with any provision of the Supplementary General Conditions, shall have no meaning in the contract and shall be disregarded.

010020-2 SPECIFICATION INFORMATION

The Specifications which govern the materials and equipment to be furnished and the work to be performed under this Contract are listed in the Table of Contents at the beginning of this volume.

No attempt has been made in the specifications to segregate work to be performed by any trade or subcontract. Any segregation between the trades or crafts will be solely a matter for agreement between the Contractor and his employees and subcontractors.

The specifications as a whole will govern the constitution of the entire work. The applicable provisions thereof will govern work to be performed under each Section.

010020-3 WORK INCLUDED

Work specified in any Section of the Specification shall mean "All labor, material, appliances and/or equipment necessary to complete all work under that section, required by the drawings and Specifications.

010020-4 WORK TO BE PERFORMED BY OTHERS

Work to be performed under separate contracts outside the scope of these contract documents, in connection with the work to be done, will include the furnishing of all materials and equipment, tools and plant, and the performances of all labor necessary in connection with the following:

A. All third-party and special inspections

The Contractor shall note in subsequent sections of this Specification his responsibility of informing separate Contractors, such as soil and concrete testers, at the appropriate time for them to perform their tasks and shall coordinate and provide such means as is customarily required by them pursuant thereto. All costs for the work required to coordinate the Contractor's work with all separate contractors shall be included in the Contract Amount.

010020-5 LAYOUT

The General Contractor shall layout the buildings and all work in connection therewith, as indicated on the drawings, and he shall be held responsible for accurately locating and maintaining all property lines, bench marks, building lines, column centers and wall lines, and establishing all elevations for floor, ceilings, roof decks, rough and finish grades, etc., as shown on the drawings or specified herein.

010020-6 CONSTRUCTION SIGN

Contractor shall furnish and erect one 8'-0" x 8'-0" painted plywood sign incorporating the development rendering and such other information as will be provided by the development team.

010020-7 EQUIVALENT MATERIALS AND EQUIPMENT

Whenever a material or article is specified or described by using the name of a proprietary product or the name of a particular manufacturer or vendor, the specific item mentioned shall be understood as establishing the type, function and quality desired. Other manufacturer's products will be accepted provided sufficient information is submitted to allow the Architect to determine that the products proposed are equivalent to those named.

010020-8 MANUFACTURER'S DIRECTIONS

All manufactured items, materials and equipment shall be installed, erected, applied, used, conditioned, adjusted and cleaned in strict accordance with the current printed directions, instructions and recommendations of the manufacturer, and with the current printed standard specifications which are issued and recommended by organized associations of manufacturers, crafts and trades, unless specifically set forth to the contrary in the applicable section of the Specifications.

010020-9 WORKMANSHIP

The workmanship shall be of the highest quality, in every respect, as usually recognized in the building industry. All surfaces, members, frames and units shall be true, even and in alignment. Connections shall be true, tight and neat. If inferior workmanship is employed the work shall be done over to conform to the highest quality standards of the trades concerned.

010020-10 CLEAN-UP AND FINAL CLEANING

The Contractor will be responsible for operating a clean site. He will also be responsible for blown material outside the site limits and will keep the area free from construction debris.

Under provisions of this Subsection, as work is completed by the various subcontractors, it shall be his responsibility to remove all excess material, equipment and debris from that area premises.

If there are special clean-up conditions they shall be listed in that particular section of the Specifications.

The General Contractor shall examine the work area to determine the extent of cleaning involved as

part of the work of each particular trade, including removal of excess material, debris, equipment and protective coverings, and final cleaning, and shall properly coordinate his cleaning work with that of all subcontractors so that, at the time of preliminary acceptance, each and every portion of the building will be in a clean condition, ready for occupancy and use. Upon preliminary acceptance, the General Contractor will be relieved of further responsibility for cleaning with the exception of such specific items as are listed in the report of deficiencies at the time of inspection and acceptance.

In addition to the cleaning required under the various separate Sections of the Specification, the General Contractor shall perform all special cleaning required. All methods and materials used for cleaning work shall comply with the current recommendations of the manufacturer or supplier of the material used, and shall be subject to approval by the Architect.

General Cleaning and Clean-Up

Remove all temporary buildings, sheds, toilet facilities, barricades, and signs from the premises.

Sweep all sidewalks, driveways and parking areas.

Remove all miscellaneous excess material, containers and debris from the premises.

Janitor-Type Cleaning

Dust all painted surfaces and wash off any soiled spots.

Remove all paint spots, putty, glazing compound, dirt and other extraneous matter from all glass, tile, marble, plumbing fixtures, etc., then wash, dry and polish.

Clean and polish all hardware, aluminum, stainless steel, brass, bronze and baked enamel surfaces.

Wash all exposed concrete floors.

010020-11 GUARANTEES

Unless longer term guarantees are called for in any Section, any and all defects in materials and workmanship which develop within one year from the date of final acceptance shall be remedied by the Contractor without additional cost to the Owner. Such remedies shall include, but not be limited to, the repair or replacement of the defective work and all other work that may be incidental to correct the work to its originally required condition in every respect. All special guarantees required by the specifications shall be furnished in acceptable form, in duplicate, to the Architect by the Contractor. All such guarantees shall include the acceptance of responsibility by the Subcontractor doing work, the period of the guarantee, and shall fully cover the work of the subcontract. The date of final acceptance shall be the beginning date of the guarantee period. Guarantees shall be furnished prior to final payment.

All Guarantees and/or Warranties shall be assigned to the Owner.

010020-12 LAWS AND REGULATIONS

The Contractor shall observe and comply with all ordinances, laws and regulations, and shall protect and indemnify the Owner against any claim or liability arising from or based on any violation of the same.

The Contractor shall comply with all regulations of agencies having jurisdiction with respect to sanitation and safety during construction.

010020-13 CONTRACTOR'S LIABILITY INSURANCE

In addition to Article II of the General Conditions, the following shall be added:

General: The Contractor shall not commence work under this Contract until he has obtained the Owner's approval of a certificate of insurance providing evidence that he has obtained all the insurance required under this subsection, at least equal to the limits set forth hereinafter, in an insurance company acceptable to the Owner.

All policies shall provide for ten days' written notice to the Owner prior to effective date of any changes affecting the policy. Two copies of the certificate of insurance in a form acceptable to the Owner shall be delivered to the Owner.

The Contractor shall not allow any Subcontractor to commence work under this Subcontract until the Subcontractor has obtained insurance coverage similar to that required by the Contractor.

Workmen's Compensation and Employee's Liability Insurance: The Contractor shall provide Workmen's Compensation and Employee's Liability Insurance, including coverage for Occupational Disease, in conformance with current State laws.

Comprehensive General Liability: The Contractor shall provide Comprehensive General Liability Insurance, including all operations under this Contract, and such policies shall protect against all claims for bodily injury, including wrongful death, as well as all claims for property damage, with the following minimum limits:

Bodily Injury - $500,000.00 per person: $1,000,000.00 per accident
Property Damage - $500,000.00

Automobile Liability Insurance. The Contractor shall provide Comprehensive Automobile Liability Insurance covering all vehicles owned, non-owned and hired and such policies shall protect against all claims for bodily injury, including wrongful death, as well as all claims for property damage, with the following minimum limits:

Bodily Injury - $500,000.00 per person: $1,000,000.00 per accident
Property Damage - $250,000.00 per accident

010020-14 BUILDER'S RISK INSURANCE

The Contractor shall furnish Builder's Risk Insurance and assume the deductible.

010020-15 SAFETY STANDARDS

The provisions of Article 10.1 - Safety Precautions and Programs, of the General Conditions, are hereby modified by the following:

A. The Contractor shall not require or permit any laborer or mechanic, including apprentices and trainees, employed in the performance of this contract to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his health as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation (29 CFR Part 1926, 36FR 7340, April 17, 1971) pursuant to Section 107 of the Contract Work Hours and Safety Standards Act, any current additions or modifications thereto.

010020-16 TEMPORARY UTILITIES

All Temporary Utilities including electricity, water, heat, telephone and toilet shall be furnished by the General Contractor.

010020-17 SHOP DRAWINGS

If required by any Section of the Specifications, the Contractor shall prepare and submit to the Architect for approval, electronic copies of complete shop drawings and physical samples for all materials required by that Section. Work shall not proceed until such approval is received. When construction conditions permit, the Contractor shall field verify all field dimensions and shall be fully responsible for the accuracy of all dimensions.

010020-18 POWER OF ATTORNEY

Attorneys-in-fact who sign contract bonds must file with each one a certified and effectively dated copy of their power of attorney.

010020-19 MEASUREMENTS

Verify all dimensions shown on Drawings by taking field measurements; proper fit and attachments of all specified items and work is required.

010020-20 SUBCONTRACTORS

Contractor shall provide to the Owner a list of names, addresses and current telephone numbers of any and all subcontractors used for construction and services of the project.

010020-21 PERMITS

The Contractor shall, at no cost to the Owner, procure all permits, licenses, pay all charges and fees, give all notices necessary, obtain and furnish to the Owner all certificates for work for which certificates are required, pay for all federal, state and local fees, permits, licenses, taxes, etc. for construction and final connection to all public utilities. The Owner may elect to pay the cost of selected Permits.

010020-22 OCCUPANCY CERTIFICATE

Contractor must secure a use and occupancy permit for the Owner prior to the scheduled date of commencement for fixturization. For purposes of interpretation of this sentence, a failure to perform any duty required of the Contractor shall not constitute reasonable grounds for the Contractor's failure to obtain a use and occupancy permit for the Owner.

010020-23 COORDINATION

The Contractor is solely responsible for coordination of work between all trades and will identify all blocking, surface preparation and similar items that are necessarily provided by one trade to facilitate the work of any other. The Contractor agrees to use every effort to keep upon the job at all times an adequate supply of workmen and materials and to secure its execution in the best and soundest way and in the most expeditious and economical manner consistent with the interests of the Owner. All trades will be required to report any deficiencies on the project which would lead to an incomplete or poor quality finished product.

010020-24 INSPECTION

Each trade shall examine all subsurfaces and work of others that affect their individual scope of work. Report in writing, to the General Contractor, with a copy to the Architect, any conditions, except for unforeseen existing conditions, which may prove detrimental to the Work. Failure to observe this injunction will constitute a waiver to any subsequent claims to the contrary and make this Contractor responsible for any correction Architect may require. Commencement of Work will be construed as acceptance of all subsurfaces.

010020-25 UTILITY FEES

The Owner will pay all utility fees charged by and payable directly to the Utility Companies.

010020-26 TIME EXTENSION FOR ADVERSE WEATHER

A. The Contractor shall comply with all provisions of the General Conditions in submitting any request for extension of Contract Time due to unusually severe weather.

B. Definitions:

1. Adverse Weather – atmospheric conditions at a definite time and place which are unfavorable to construction activities.
2. Unusually Severe Weather - weather which is more severe than the adverse weather anticipated for the season, location, or activity involved.

C. In order for any request of time extension due to unusually severe weather to be valid, the Contractor must document both of the following conditions.

1. The weather experienced at the project site during the Contract period is more severe than the adverse weather anticipated for the project location during any given month.
2. The unusually severe weather actually caused a delay to the scheduled progress and/or completion of the project. The delay must be beyond the control and without fault or negligence by the Contractor.

D. The following schedule of monthly anticipated adverse weather delays will constitute the baseline for monthly weather time evaluations. The contractor's progress schedule must reflect these anticipated adverse weather delays in all weather-affected activities:

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY WORK DAYS

BASED ON FIVE (5) DAY (Monday – Friday) WORK WEEK

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10	8	7	6	7	7	5	5	5	4	5	9

E. Upon receipt of the Notice to Proceed, and continuing throughout the contract, the Contractor shall record on their daily construction report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50% or more of contractor's scheduled workday.

F. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in the previous month), and shall be calculated chronologically from the first to the last day of each month, and be recorded as full workdays.

1. If the number of actual adverse weather delay days in a given month exceeds the number of days anticipated in Paragraph D, above, the difference shall be multiplied by 7/5 to convert any qualifying workday delays to calendar days. The resulting number of qualifying lost days shall be added upon approval by the Architect and Owner to the contract time.

2. The determination that unusually severe weather occurred does not automatically mean an extension of time will be granted. The contractor must substantiate the unusually severe weather delayed work activities on the critical path of the Progress Schedule.

G. Full consideration for equivalent fair weather workdays shall be given. If the number of actual adverse weather delays in a given month is less than the number of days anticipated in Paragraph D, above, the difference shall be multiplied by 7/5 to convert any work day increases to calendar days. The resulting number of qualifying extra

days will be accumulated and subtracted from any future month's days lost due to unusually severe weather.

1. The net cumulative total of extra days/lost days shall not result in a reduction of Contract Time and the Date of Substantial Completion shall not be changed as a result of unusually favorable weather.

H. In converting workdays to calendar days fractions less than 0.5 shall be rounded up to the next whole number. Fractions less than 0/5 shall be dropped.

I. The contractor shall summarize and report all actual adverse weather delay days for the preceding month to the architect by the tenth (10^{th}) day of the following month. A narrative indicating the impact of adverse weather conditions on the scheduled critical activities shall be included.

1. Any request or claim for an extension of time due to unusually severe weather shall be submitted to the architect and owner within twenty-one (21) days of the last day of the month in which the delay occurred. Resolution of any weather delay claim shall follow the procedures established by the general conditions and as prescribed above.

J. The contractor shall include and indicate the monthly anticipated adverse weather days listed in Paragraph D, above, in their progress schedule.

1. The contractor shall indicate the actual adverse weather days (whether less or more than the anticipated days) in their monthly progress schedule update.

010020-27 TIME EXTENSION FOR FACTORS OTHER THAN WEATHER

A. If the contractor incurs a delay due to factors out of his control, the contractor shall submit a claim within twenty-one (21) days after the occurrence of the delay to the architect and project team. The claim shall include a description of the cause of the delay and resultant request for additional time.

B. If a proposal request for additional work causes the contractor additional time to perform the original contract requirements the contractor may submit a claim for additional time to the Architect and Owner. The Contractor shall include in his proposal the request for time extension (if any), and shall include sufficient information and dates to demonstrate whether and to what extent the change will delay the completion of the contract in its entirety.

C. The determination that delays have occurred beyond the Contractor's control does not automatically mean an extension of time will be granted. The Contractor must substantiate the delay by indicating suspended work activities on the critical portion of the project schedule.

END OF SECTION 010020

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Contractor's use of site and premises.
2. Work restrictions.
3. Specification and Drawing conventions.

1.3 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1.4 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

1.5 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form provided in Project Manual.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
    b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

    a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    b. Substitution request is fully documented and properly submitted.
    c. Requested substitution will not adversely affect Contractor's construction schedule.
    d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    e. Requested substitution is compatible with other portions of the Work.
    f. Requested substitution has been coordinated with other portions of the Work.
    g. Requested substitution provides specified warranty.
    h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

    a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    b. Requested substitution does not require extensive revisions to the Contract Documents.
    c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    d. Substitution request is fully documented and properly submitted.
    e. Requested substitution will not adversely affect Contractor's construction schedule.
    f. Requested substitution has received necessary approvals of authorities having jurisdiction.
    g. Requested substitution is compatible with other portions of the Work.
    h. Requested substitution has been coordinated with other portions of the Work.
    i. Requested substitution provides specified warranty.
    j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, or other form acceptable to the Owner and Contractor.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 or a form acceptable to the owner and Contractor.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714 or other form acceptable to the owner and contractor. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

a. Project name and location.
b. Owner's name.
c. Owner's Project number.
d. Name of Architect.
e. Architect's Project number.
f. Contractor's name and address.
g. Date of submittal.

2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:

    a. Related Specification Section or division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.

        1) Labor.
        2) Materials.
        3) Equipment.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site.

5. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
6. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
8. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

    1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Schedule of unit prices.
6. Submittal schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. Data needed to acquire Owner's insurance.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706, “Contractor’s Affidavit of Payment of Debts and Claims.”
6. AIA Document G706A, “Contractor’s Affidavit of Release of Liens.”
7. AIA Document G707, “Consent of Surety to Final Payment.”
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Requests for Information (RFIs).
3. Digital project management procedures.
4. Web-based Project management software package.
5. Project meetings.

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, on Project Web site, and in prominent location in built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
3. Contractor shall endeavor to respond to subcontractor RFI’s first, prior to sending to Architect for a response.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.

2. Owner name.
3. Name of Architect.
4. Architect's Project number.
5. Date.
6. Name of Contractor.
7. RFI number, numbered sequentially.
8. RFI subject.
9. Specification Section number and title and related paragraphs, as appropriate.
10. Drawing number and detail references, as appropriate.
11. Field dimensions and conditions, as appropriate.
12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
13. Contractor's signature.
14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

    1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

    1. The following Contractor-generated RFIs will be returned without action:

        a. Requests for approval of submittals.
        b. Requests for approval of substitutions.
        c. Requests for approval of Contractor's means and methods.
        d. Requests for coordination information already indicated in the Contract Documents.
        e. Requests for adjustments in the Contract Time or the Contract Sum.
        f. Requests for interpretation of Architect's actions on submittals.
        g. Incomplete RFIs or inaccurately prepared RFIs.

    2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
    3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

        a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log at every Owner, Architect, Contractor (OAC) Meeting. Include the following:

    1. Project name.

2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project management software includes, at a minimum, the following features:

a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
c. Document workflow planning, allowing customization of workflow between project entities.
d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
e. Track status of each Project communication in real time, and log time and date when responses are provided.
f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
g. Processing and tracking of payment applications.
h. Processing and tracking of contract modifications.
i. Creating and distributing meeting minutes.
j. Document management for Drawings, and Specifications, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to seven Project management software user licenses for use of Owner, Architect, and Architect's consultants. Provide up to eight hours of software training at Architect's office for web-based Project software users if needed.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.

B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Responsibilities and personnel assignments.
b. Tentative construction schedule.
c. Phasing.
d. Critical work sequencing and long lead items.
e. Designation of key personnel and their duties.
f. Lines of communications.
g. Use of web-based Project software.
h. Procedures for processing field decisions and Change Orders.
i. Procedures for RFIs.
j. Procedures for testing and inspecting.
k. Procedures for processing Applications for Payment.
l. Distribution of the Contract Documents.
m. Submittal procedures.
n. Preparation of Record Documents.
o. Use of the premises and existing building.
p. Work restrictions.
q. Working hours.
r. Owner's occupancy requirements.
s. Responsibility for temporary facilities and controls.
t. Procedures for moisture and mold control.
u. Procedures for disruptions and shutdowns.
v. Parking availability.
w. Office, work, and storage areas.

x. Equipment deliveries and priorities.
y. First aid.
z. Security.
aa. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

    a. Preparation of Record Documents.
    b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    c. Procedures for completing and archiving web-based Project software site data files.
    d. Submittal of written warranties.
    e. Requirements for preparing operations and maintenance data.
    f. Requirements for delivery of material samples, attic stock, and spare parts.
    g. Preparation of Contractor's punch list.
    h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    i. Submittal procedures.
    j. Coordination of separate contracts.
    k. Owner's partial occupancy requirements.
    l. Installation of Owner's furniture, fixtures, and equipment.
    m. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at a minimum of biweekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: Each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

    b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site use.
9) Temporary facilities and controls.
10) Progress cleaning.
11) Quality and work standards.
12) Status of correction of deficient items.
13) Field observations.
14) Status of RFIs.
15) Status of Proposal Requests.
16) Pending changes.
17) Status of Change Orders.
18) Pending claims and disputes.
19) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's Construction Schedule.
2. Construction schedule updating reports.
3. Daily construction reports.
4. Site condition reports.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for schedule of tests and inspections.
2. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. PDF file.

B. Startup Construction Schedule.

1. Approval of cost loaded start-up schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

D. Construction Schedule Updating Reports: Submit with Applications for Payment.

E. Daily Construction Reports: Submit at monthly intervals.

F. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Time Frame: Extend schedule from date established for commencement of the Work to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.

6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of the following items on the schedule:

a. Coordination with existing construction.
b. Limitations of continued occupancies.
c. Uninterruptible services.
d. Partial occupancy before Substantial Completion.
e. Use-of-premises restrictions.
f. Provisions for future construction.
g. Seasonal variations.
h. Environmental control.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

F. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.6 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1.7 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
6. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
7. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include

additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.5 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Category and type of submittal.
8. Submittal purpose and description.
9. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
10. Drawing number and detail references, as appropriate.
11. Indication of full or partial submittal.
12. Location(s) where product is to be installed, as appropriate.
13. Other necessary identification.
14. Remarks.
15. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include

relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.

    a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is necessary, allow 21 days for initial review of each submittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.7 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams that show factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.

b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit two full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents.

Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action**.**
2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

B. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:

a. Verify selections made under Sample submittals.
b. Demonstrate aesthetic effects.

c. Demonstrate the qualities of products and workmanship.
d. Demonstrate successful installation of interfaces between components and systems.
e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 ACTION SUBMITTALS

A. Mockup Shop Drawings:

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.7 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.

7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.

1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

3. Provide sizes and configurations of test assemblies, and mockups, to adequately demonstrate capability of products to comply with performance requirements.
4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

6. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
7. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
9. Demolish and remove mockups when directed unless otherwise indicated.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

    a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
2. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
4. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
5. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for requests for substitutions.
2. Section 014200 "References" for applicable industry standards for products specified.
3. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

    a. Name of product and manufacturer.
    b. Model and serial number.
    c. Capacity.
    d. Speed.
    e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.

    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certified Surveys: Submit two copies signed by professional engineer.

C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

D. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.

3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.

E. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.4 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."

C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Plumbing piping systems.
    f. Mechanical systems piping and ducts.
    g. Control systems.
    h. Communication systems.
    i. Electrical wiring systems.
    j. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Exterior curtain-wall construction.

d. Sprayed fire-resistive material.
e. Equipment supports.
f. Piping, ductwork, vessels, and equipment.
g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.

7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

D. Final Property Survey: Engage a professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Existing Utility Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption to occupied areas.

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

    a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove snow and ice to provide safe access to building.
    f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural

weathering of exterior surfaces. Restore reflective surfaces to their original condition.

g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Emergency manuals.
   2. Systems and equipment operation manuals.
   3. Systems and equipment maintenance manuals.
   4. Product maintenance manuals.

B. Related Requirements:

   1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

   1. Architect and its consultants will comment on whether content of operation and maintenance submittals is acceptable.
   2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

   1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.

C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion. Architect will return copy with comments.

   1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments.

D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Architect.
7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
8. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.

4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures,

maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up record prints.

B. Record Specifications: Submit annotated PDF electronic files of the Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.

4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

    a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.

b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

B. Format: Submit record specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 033000 CAST-IN-PLACE CONCRETE

PART 1- GENERAL

1.1 SUMMARY

A. Supply and install all Cast-in-Place Concrete as shown on the Drawings and as specified herein.

1.2 COMPLIANCE WITH STANDARDS

A. All concrete shall conform to the applicable requirements of the latest editions of the following standards:

ACI 211.1	Recommended Practice for Selecting Proportions for Concrete.
ACI 214	Recommended Practice for Evaluation of Compressive Test Results of Field Concrete.
ACI 301	Structural Concrete for Buildings.
ACI 304	Recommended Practice for Measuring, Mixing and Placing Concrete.
ACI 305	Recommended Practice for Hot Weather Concreting.
ACI 306	Recommended Practice for Cold Weather Concreting.
ACI 309	Recommended Practice for Consolidation of Concrete.
ACI 315	Manual of Standard Practice for Detailing Reinforced Concrete Structures.
ACI 318	Building Code Requirements for Reinforced Concrete.
ACI 347	Recommended Practice for Concrete Framework.

1.3 CONCRETE QUALITY CONTROL

A. The Owner shall select the testing laboratory to perform control and tests. Contractor shall obtain Engineer's approval of mix designs prior to placing of concrete. The Contractor shall notify the laboratory 24 hours in advance of each pour to allow proper performance of their duties.

B. Test specimens shall be taken from each pour of 50 cubic yards of each Class of concrete or portion thereof, and four specimens of 6x12 cylinders shall be taken for each test. Slump tests shall be taken at the time cylinders are made. Air content shall be checked for Class B concrete. Test one cylinder at 7 days and two cylinders at 28 days with the fourth cylinder being retained as a spare. Submit test reports, including slump, air content and strength to the Engineer.

1.4 STRENGTH OF CONCRETE

A. Concrete properties - All Cast-In-Place concrete shall conform to the following requirements:

Class	Slump Range	Air Entrainment Range	28 Day Design Compressive Strength (fc) P.S.I.
A	4"+/-1"		3500 P.S.I. (Maximum W /C Ratio = 0.50)
B	4"+/-1"	5% - 7%	4500 P.S.I. (Minimum 6 sack mix) (Maximum W/C Ratio = 0.42)
C	4"+/-1"		4000 P.S.I. (Maximum W/C Ratio = 0.45)
D	4"+/-1"	5% - 7%	3500 P.S.I. (Maximum W /C Ratio = 0.50)

Class A concrete shall include all footings and grade beams.

Class B concrete shall include all exterior flat work and detached garage slabs.

Class C concrete shall include all interior slabs on grade.

Class D concrete shall include all concrete walls.

The air-entraining agent added to the Portland Cement mixture shall be compatible with the Portland Cement used.

No admixtures shall be used unless approved by the Structural Engineer.

PART 2- SPECIFIC REQUIREMENTS

2.1 MATERIALS

A. Portland Cement shall conform to ASTM Specification C150, Type I. Air entraining cement shall be used for curbs and walks only and shall conform to ASTM Specification C175.

B. Coarse aggregate shall conform to the quality and gradation requirement of ASTM Specification C33. The grading requirement shall be from 3/4" to No. 4 sieve.

C. Concrete sand shall be natural medium sand and conform to the quality and gradation requirements of ASTM Specification C33.

D. Mixing water shall be potable.

E. Reinforcing steel shall conform to ASTM Specification A615, Grade 60.

F. Welded wire fabric shall be 6x6 – W2.9xW2.9 unless otherwise noted and conform to ASTM Specification A185, and A82. Flat Sheets may be used.

G. Expansion joint fillers shall conform to ASTM Designation D751, non-extruding, resilient, bituminous type.

H. Curing Compounds - One of the following:

1. Ravan - "MgSF"
2. Hillyard - "Cem_Seal",
3. Sonneborn - "Lapidolith"

I. Perimeter foundation insulation shall be as indicated, 2" thick by 24" high Styrofoam brand square edge as manufactured by Dow Chemical Co. or approved equal.

J. Base under interior concrete slabs shall be a minimum of 4" thick base of 1/2" to 3/4" clean free draining crushed limestone over unless otherwise noted.

K. Vapor barrier under interior concrete slabs shall be 15 mil. polyethylene.

L. Anchor bolt sizes and spacings shall be as indicated on the Structural Drawings.

M. Balcony plywood sheathing shall be covered with sheet membrane waterproofing as specified in Section 071326, Sheet Membrane Waterproofing.

PART 3 - EXECUTION

3.1 FORMWORK

A. Forms shall be built of such materials and in such a manner that they are completely rigid and strong enough to withstand without deflection, movement or leakage, the high hydraulic pressures which result from rapid filling and heavy high frequency vibration.

B. Design of forms shall be the Contractor's responsibility and shall comply with recommendations given in ACI 347.

C. Construct forms to lines and dimensions shown, plumb and straight, level and true. Securely brace and shore to prevent displacement and to safely support construction loads. Layout of forms for exposed walls and slabs shall be regular and uniform. All form work and finished surfaces shall conform to the requirements of ACI 347.

D. All forms shall be left in place for the periods recommended in ACI 347.

E. After forms have been removed all form ties shall be removed. The concrete shall have all ridges and droppings removed and voids and large holes grout patched.

3.2 REINFORCEMENT

A. Footings, foundation walls, brackets, pads, columns, and grade beams shall be of reinforced concrete as indicated.

B. All metal reinforcement, at the time concrete is placed, shall be free from rust, oil and other foreign matter which could reduce or destroy the bond. Placement shall be as indicated, securely fastened in place with wire, spacers, etc. to prevent displacement before and during concrete pour, with cover as noted on Drawings. Bending and placing of reinforcement shall be done in accordance with all applicable requirements of the ACI and CRSI.

C. The Contractor shall notify the Architect sufficiently in advance of a proposed concrete pour, that the Architect will have sufficient time to inspect the work. This does not relieve the Contractor of his responsibility to insure that the construction is in accordance with the Plans and Specifications.

D. Welded wire fabric shall have lapped splices so made that the overlap measure between outermost cross wires of each fabric sheet is not less than one wire spacing. It shall be extended through contraction joints and construction joints. Fabric shall be supported on continuous slab supports or concrete blocks.

3.3 EMBEDDED ITEMS

A. Prior to placing of concrete, care shall be taken to assure that all required embedded items are firmly and securely fastened in place as required. No aluminum items shall be embedded in any concrete.

B. Miscellaneous items, including anchor bolts, bearing plates, inserts, sleeves, boxes, etc. will be furnished and installed under other sections, or furnished only by others for installation in forms and concrete under this Section. In all cases, they shall be accurately located to meet the requirements of related items prior to placement of concrete.

3.4 PROTECTION

A. Concrete work shall conform to ACI 306 and ACI 305 appropriately when temperatures and climatic conditions may impair concrete quality and/or strength.

3.5 CONCRETE FINISHES

A. Exterior slabs on grade shall have expansion and control joints as indicated or required. Slabs shall be reinforced with welded wire mesh and poured to required thickness. Exterior slabs shall receive a light broom finish and shall be sloped to drain except concrete curb ramps shall receive a rake finish with grooves perpendicular to the slope of the ramp.

B. Interior slabs on grades shall have a minimum 4" thick base of 1/2" to 3/4" clean crushed limestone, membrane vapor barrier, and expansion and control joints as indicated or required. Slabs shall be reinforced with welded wire mesh and poured to required thickness. Interior slabs shall receive a smooth hard troweled monolithic finish and shall be true to a straight edge with 1/4" tolerance in 10'.

C. Balcony slabs shall receive a light broom finish. Balcony slabs shall have a uniform slope to drain of at least 1/8” per 1’-0”.

3.6 CURING

A. Curing of all concrete shall be done in accordance with ACI 308 "Recommended Practice for Curing Concrete". Protection and support of concrete members shall be required for the time periods specified in ACI 347 "Recommended Practice for Concrete Formwork".

3.7 DEFECTIVE CONCRETE

A. Defective concrete is defined as concrete which does not comply with strength or slump limitations; is not formed as detailed; is not true to lines and elevations indicated, in which reinforcing steel is not properly placed, or which has excessive voids, honeycombing or embedded debris. Such concrete shall be removed and replaced as directed by the Architect. All costs resulting from defective concrete shall be paid by the Contractor.

3.8 FOOTINGS

A. No concrete shall be placed in footings until the soil engineer has inspected and approved the founding material to safely support the design bearing pressures and the special inspector has inspected and approved the reinforcing steel placement.

END OF SECTION 033000

SECTION 033010 UNDER-SLAB VAPOR BARRIER

PART 1 - GENERAL

1.1 SUMMARY

A. Products supplied under this section:

1. Vapor barrier and installation accessories for installation under concrete slabs.

B. Related sections:

1. Section 033000 Cast-in-Place Concrete.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM E1745: Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
2. ASTM E1643: Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

B. Technical Reference - American Concrete Institute (ACI):

1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
2. ACI 302.1R-15 Guide to Concrete Floor and Slab Construction.

1.3 SUBMITTALS

A. Quality control/assurance:

1. Summary of test results per paragraph 9.3 of ASTM E1745.
2. Manufacturer's samples and literature.
3. Manufacturer's installation instructions for placement, seaming, penetration prevention and repair, and perimeter seal per ASTM E1643.
4. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Vapor barrier shall have all of the following qualities:

1. Maintain permeance of less than 0.01 Perms [grains/(ft^2 · hr · inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
2. Other performance criteria:

a. Strength: ASTM E1745 Class A.
b. Thickness: 15 mils minimum

3. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1

B. Vapor barrier products:

1. Basis of Design: Stego Wrap Vapor Barrier (15-mil) by Stego Industries LLC., (877)-464-7834. www.stegoindustries.com.
2. Approved Alternate: Griffolyn 15 by Reef Industries, (713)-507-4250. www.reefindustries.com.
3. Approved Alternate: Moistop Ultra 15 by, Henry Company, (800)-485-1278. www.henry.com.

1.2 ACCESSORIES

A. Seams:

1. Stego Tape by Stego Industries LLC or approved equal.

B. Sealing Penetrations of Vapor barrier:

1. Stego Mastic by Stego Industries LLC or approved equal.
2. Stego Tape by Stego Industries LLC or approve equal.

C. Perimeter/edge seal:

1. Stego Crete Claw by Stego Industries LLC or approved equal.
2. Stego Term Bar by Stego Industries LLC or approved equal.
3. StegoTack Tape (double-sided sealant tape) by Stego Industries LLC or approved equal.

D. Penetration Prevention:

1. Beast Foot by Stego Industries LLC or approved equal.

E. Vapor Barrier-Safe Screed System:

1. Beast Screed by Stego Industries, LLC or approved equal

PART 3 - EXECUTION

3.1 PREPARATION

A. Ensure that subsoil is approved by Architect or Geotechnical Engineer.

1. Level and compact base material.

3.2 INSTALLATION

A. Install vapor barrier in accordance ASTM E1643.

1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.

2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments, such as dowels, waterstops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.

   a. Seal vapor barrier to the entire slab perimeter using Stego Crete Claw, per manufacturer's instructions.

   OR

   b. Seal vapor barrier to the entire perimeter wall or footing/grade beam with double sided StegoTack Tape, or both Stego Term Bar and StegoTack Tape, per manufacturer’s instructions. Ensure the concrete is clean and dry prior to adhering tape.

3. Overlap joints 12 inches and seal with manufacturer’s seam tape.
4. Apply seam tape/Crete Claw to a clean and dry vapor barrier.
5. Seal all penetrations (including pipes) per manufacturer’s instructions.
6. For interior forming applications, avoid the use of non-permanent stakes driven through vapor barrier. Use blunt-end and/or threaded nail stakes (screed pad posts) and insert them into Beast Foot. Ensure Beast Foot’s peel-and-stick adhesive base is fully adhered to the vapor barrier.
7. If non-permanent stakes are driven through vapor retarder, repair as recommended by vapor retarder manufacturer.
8. Use reinforcing bar supports with base sections that eliminate or minimize the potential for puncture of the vapor barrier.
9. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.
10. For vapor barrier-safe concrete screeding applications, install Beast Screed (vapor barrier-safe screed system) per manufacturer’s instructions prior to placing concrete.

END OF SECTION 033010

SECTION 035413 GYPSUM CEMENT FLOOR UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Supply and install all gypsum cement floor underlayment as shown on the Drawings and as specified herein.

1.2 QUALITY ASSURANCE

A. Installer's Qualifications: Installer shall be authorized by the manufacturer using approved mixing and pumping equipment

PART 2 - PRODUCTS

2.1 MATERIALS

A. Gypsum cement floor underlayment shall be Gyp-Crete 2000 Multifamily as manufactured by Maxxon Corporation or approved equal.

B. Sound reduction mat shall be Acousti-Mat 1/8 Sound Control Mat by Maxxon Corporation or approved equal under areas to receive vinyl flooring in all apartment units.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Product installation shall be in strict accordance with the written installation instructions of the manufacturer.

B. Mix Design shall be per manufacturer’s written installation recommendations. The underlayment shall attain a typical compressive strength of 2,000 psi to 3,200 psi. Place gypsum cement underlayment 3/4-inch-thick over sound control mat over the entire second floor multi-family areas, except omit the sound reduction board at areas scheduled to receive carpet and pad.

C. Subfloor shall be minimum 23/32" OSB with American Plywood Association trademark and fastened according to APA recommendations. Subfloor to be in sound condition, broom clean and free from contaminates.

D. Prime the subfloor using the gypsum cement floor underlayment manufacturer’s recommended floor primer.

E. Preparation for Installation of Glue-Down Floor Goods: Seal all areas that receive glue down floor goods with Maxxon Overspray or Maxxon Acrylic according to the Maxxon Corporation's specifications. Any floor areas where the surface has been damaged shall be cleaned and sealed regardless of floor covering to be used. Where floor goods manufacturers require special adhesive or installation systems, their requirements supersede these recommendations.

F. See Maxxon Corporation's "Procedures for Attaching Finished Floor Goods to Maxxon Underlayments" brochure for guidelines for installing finished floor goods. This procedure is not a warranty and is to be used as a guideline only.

END OF SECTION 035413

SECTION 042200 CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Steel reinforcing bars.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product. For masonry units, include data on material properties.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.5 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.

A. Standard CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
2. Density Classification: Normal weight unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.

2.3 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C 144.

1. White-Mortar Aggregates: Natural white sand or crushed white stone.

E. Aggregate for Grout: ASTM C 404.

F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

H. Water: Potable.

2.4 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60, 1/2" bars.

B. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.

1. Continuous masonry wire reinforcing shall be minimum 9 gauge welded wire, 0.8 oz., hot dip galvanized (after fabrication) of proper width for the wall thickness. Dur-O-Wall or equal, ladder or truss type.

2.5 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: "Pre-Kleened" EPDM flashing as manufactured by Carlisle or approved equal.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.6 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.

B. Provide continuity at corners by using prefabricated L-shaped units.

3.6 FLASHING

A. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions.

3.7 REINFORCED UNIT MASONRY INSTALLATION

A. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.8 CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

C. At the completion of the work the Contractor shall remove all excess material, debris, scaffolds and equipment, leaving the areas broom clean.

END OF SECTION 042200

SECTION 044313.19 - ADHERED MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Masonry adhered to wood framing and sheathing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of brick, accessory, and manufactured product.

B. Samples:

1. For each brick types indicated. Include at least three Samples in each set, and show the full range of color and other visual characteristics in completed Work.
2. For each color of mortar required. Label Samples to indicate types and amounts of pigments used.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Test Reports:

1. Test Reports: For each brick type proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous five years.
2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer, indicating that sealants will not stain or damage brick. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs experienced masons.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Sealant Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, in a dry location, or in covered weatherproof dispensing silos.

1.8 FIELD CONDITIONS

A. Protection of brick: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides, and hold cover securely in place.

B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining masonry face.

1. Protect base of walls from rain-splashed mud and mortar splatter, using coverings spread on the ground and over the wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at end of each day to prevent rain from splashing mortar and dirt on completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace masonry damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1.9 COORDINATION

A. Advise installers of other work about specific requirements for placement of flashing and similar items to be built into masonry.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Brick: Obtain each variety of brick, regardless of finish, from single quarry with resources to provide materials of consistent quality in appearance and physical properties.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from single manufacturer and each aggregate from single source or producer.

2.2 THIN BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications including corners, movement joints, bond beams, sashes, and lintels.

B. Clay Thin Brick: Thin brick complying with ASTM C216, Grade SW, Type TBS.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acme Brick Company.
b. Belden Brick Company (The).
c. Endicott Clay Products Co.
d. General Shale, Inc.
e. Glen-Gery Corporation.

2. Color and Texture: As selected by Developer.

B. MORTAR MATERIALS

C. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; natural color or white cement may be used as required to produce mortar color indicated.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.

D. Hydrated Lime: ASTM C207, Type S.

E. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Davis Colors.
b. Solomon Colors Inc.
c. Spec Mix.

G. Aggregate: ASTM C144 and as follows:

1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 sieve.
2. White Aggregates: Natural white sand or ground white stone.
3. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.

H. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bostik, Inc.
b. H.B. Fuller Construction Products Inc. / TEC.
c. Laticrete International, Inc.
d. MAPEI Corporation.
e. Parex USA, Inc.

I. Water: Potable.

2.3 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Metal Drip Edges: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
4. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.

B. Flexible Flashing: For flashing unexposed to the exterior, use the following unless otherwise indicated:

1. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 0.040 inch thick.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Carlisle Coatings & Waterproofing Inc.
2) Firestone Building Products.
3) GCP Applied Technologies, Inc.
4) Heckmann Building Products, Inc.
5) Hohmann & Barnard, Inc.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at wall face, use metal flashing or flexible flashing with a metal drip edge.
4. Where flashing is fully concealed, use metal flashing or flexible flashing.

D. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Stainless Steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless steel sheet manufacturer.
2. Elastomeric Sealant: ASTM C920, chemically curing polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Adhesives, Primers, and Seam Tapes for Flexible Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.4 MISCELLANEOUS MASONRY ACCESSORIES

A. Weather Barrier compliant with or better than ASTM E2556, Type II shall be installed over the wall sheathing per Section 072500 by others prior to the start of this masonry work.

B. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

C. Foundation Weep Screed: Fabricated from hot-dip-galvanized steel sheet with ASTM A653/A653M G60 zinc coating.

D. Casing Beads: Fabricated from zinc, zinc-coated (galvanized) steel, or anodized aluminum; square-edged style; with expanded flanges.

E. Expanded Metal Lath: 3.4 lb./sq. yd., self-furring, diamond-mesh lath complying with ASTM C847. Fabricate from structural-quality, zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G60.

1. Water-Resistive Barrier: Vapor-permeable paper, factory bonded to back of lath; complying with requirements in FS UU-B-790a for Type I, Grade D.

F. Drainage Mat: MTI 10mm Sure Cavity as manufactured by Masonry Technologies, Inc, Cresco, Iowa.

G. Fasteners: Shall be Type S-12 galvanized or SS with 1-1/4-inch minimum penetration into wood studs behind sheathing. Material and type required by ASTM C1063 for installations indicated.

2.5 MASONRY CLEANERS

A. Manufacturer's recommended means and methods for soap and water cleaners for removing mortar and grout stains, efflorescence, and other new construction stains from masonry surfaces ASAP, without discoloring or damaging masonry surfaces; expressly approved for intended use by the brick producer.

2.6 FABRICATION

A. General: Fabricate brick units in sizes and shapes required to comply with requirements indicated.

B. Select brick to produce pieces of thickness, size, and shape indicated, including details on Drawings and pattern specified in "Setting Masonry" Article.

C. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.

D. Carefully inspect brick at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.

1. Clean sawed backs of brick to remove rust stains and iron particles.

E. Thickness of Brick: Provide thickness indicated, but not less than the following:

1. Thickness: 1 inch plus or minus 1/4 inch.
2. Comply with Building Code maximum weight/sf requirements.

F. Finish exposed brick faces and edges to comply with requirements indicated for finish.

1. Finish: As selected by pattern name and joint selection, TBD. For all pieces, including sills, lintels, special shapes, outside corners, etc.

a. Finish exposed ends of copings same as front and back faces.

2.7 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride.
2. Use portland cement-lime mortar unless otherwise indicated.
3. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches required consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Masonry: Comply with ASTM C270, Proportion Specification.

1. Mortar for Setting Brick: Type N.
2. Mortar for Pointing Brick: Type N.

D. Cement-Paste Bond Coat: Mix either neat cement and water or cement, sand, and water to a consistency similar to that of thick cream.

1. For latex-modified portland cement, setting-bed mortar, substitute latex admixture for part or all of water, according to latex-additive manufacturer's written instructions.

E. Mortar for Scratch Coat over Metal Lath: 1-part portland cement, 1/2-part lime, 5 parts loose damp sand, and enough water to produce a workable consistency.

F. Pigmented Mortar: Use colored cement product.

1. Pigments shall not exceed 10 percent of portland cement by weight.

G. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of masonry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean dirty or stained surfaces by removing soil, stains, and foreign materials before setting. Clean brick by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 SETTING MASONRY

A. Perform necessary field cutting and trimming as stone is set.

1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping.
2. Use hammer and chisel to split stone that is fabricated with split surfaces. Make edges straight and true, matching similar surfaces that were shop or quarry fabricated.
3. Pitch face at field-split edges as needed to match stones that are not field split.

B. Brick patterns and bond patterns shall be as indicated on drawings and as selected by Owner, with special corners and trim pieces as required.

C. Set brick to comply with requirements indicated on Drawings. Install supports, fasteners, and other attachments indicated or necessary to secure masonry in place. Set brick accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

D. Maintain uniform joint widths, except where minor variations are required to maintain bond alignment if any. Lay walls with joints not less than 1/4 inch at narrowest points or more than 5/8 inch at widest points.

E. Provide sealant joints of widths and at locations indicated.

1. Keep sealant joints free of mortar and other rigid materials.
2. Sealing joints are specified in Section 079200 "Joint Sealants."

F. Install metal expansion strips in sealant joints at locations indicated. Build flanges of expansion strips into masonry by embedding in mortar between masonry and backup wythe. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.

G. Respect expansion and control joint locations for back up materials and carry thru these masonry materials to allow for wall shrinkage in height, and thermal fluctuations.

H. Install embedded flashing and weep holes at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

1. At stud-framed walls extend flashing through masonry, up sheathing face at least 12 inches, and behind weather barrier.
2. At concrete backing, extend flashing through masonry, turned up a minimum of 12 inches, and insert in reglet.
3. At lintels and shelf angles, extend flashing full length of angles but not less than 6 inches into masonry at each end.
4. At sills, extend flashing not less than 4 inches at ends.
5. At ends of head and sill flashing, turn up not less than 2 inches to form end dams.
6. Extend sheet metal flashing 1/2 inch beyond masonry face at exterior, and turn flashing down to form a drip.
7. Install metal drip edges beneath flexible flashing at exterior wall face. Stop flexible flashing 1/2 inch back from exterior wall face, and adhere flexible flashing to top of metal drip edge.
8. Install metal flashing termination beneath flexible flashing at exterior wall face. Stop flexible flashing 1/2 inch back from exterior wall face, and adhere flexible flashing to top of metal flashing termination.
9. Cut flexible flashing flush with wall face after completing masonry wall construction.

I. Place weep holes in joints where moisture may accumulate, including above shelf angles and at flashing.

1. Use perforated hot dip galvanized or stainless-steel starter track to form weep holes to drain walls.
2. Space weep holes 16 inches o.c.

3.4 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.

C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet or 3/4 inch in 40 feet or more.

D. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.

E. Variation in Plane between Adjacent Brick: Do not exceed one-half of tolerance specified for thickness of brick.

3.5 INSTALLATION OF ADHERED MASONRY VENEER

A. Install flashing over sheathing and behind building paper or wrap and drainage material by fastening through sheathing into framing.

B. Install galvanized metal lath over building paper or wrap and drainage material by fastening through sheathing into framing to comply with ASTM C1063.

C. Install scratch coat over metal lath 3/8 inch thick to comply with ASTM C926.

D. Coat backs of stone units and face of scratch coat with cement-paste bond coat, then butter both surfaces with setting mortar. Use sufficient setting mortar, so a slight excess will be forced out the edges of stone units as they are set. Tap units into place, completely filling space between units and scratch coat.

E. Rake out joints for pointing with mortar to depth of not less than 1/2 inch before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

3.6 POINTING

A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch deep until a uniform depth is formed.

B. Point stone joints by placing and compacting pointing mortar in layers of not more than 3/8 inch deep. Compact each layer thoroughly, and allow to it become thumbprint hard before applying next layer.

C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:

1. Joint Profile: Concave for thin brick unless otherwise indicated.

3.7 ADJUSTING AND CLEANING

A. Remove and replace masonry of the following description:

1. Broken, chipped, stained, or otherwise damaged brick.
2. Defective joints.
3. Brick masonry not matching approved samples.
4. Brick masonry not complying with other requirements indicated.

B. Replace in a manner that results in brick masonry matching approved samples, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: brick masonry as work progresses with soap and water, using sponges and soft brushes, and as recommended by brick manufacturers recommendations. Remove mortar fins and smears before tooling joints. This should be done prior to the mortar materials drying on the surface.

D. Final Cleaning: After mortar is thoroughly set and cured, clean masonry as follows:

1. Acidic cleaners shall not be used for brick materials. After mortar is thoroughly set and cured, clean masonry only as directed by brick manufacturers cleaning guidelines.
2. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
3. Test cleaning methods on inconspicuous area; leave one-half of area uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning masonry.
4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
5. Clean masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20, Revised II, using job-mixed detergent solution.

3.8 EXCESS MATERIALS AND WASTE

A. Excess Brick: Stack excess brick where directed by Owner for Owner's use.

B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in greatest dimension.
2. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other waste, and legally dispose of off Owner's property.

END OF SECTION 044313.16

SECTION 055000 METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Supply and install all Metal Fabrication Work as indicated on the Drawings and as specified herein.

1.2 SHOP DRAWINGS

A. Submit shop drawings including complete details for fabrication and assembly of steel members.

1.3 STANDARDS

A. The Contractor shall furnish and install all necessary sleeves, fasteners, bolts, nuts, struts, braces and other miscellaneous parts required to complete and properly install the work included in this Section.

B. All ferrous metal items shall be given a shop prime coat of FS TT-P-636 or approved equal.

C. Joints and intersections of metal shall be accurately made, tightly fitted and made in true planes, with all exposed joints mitered, welded full and ground smooth on flat surfaces and square at corners.

D. All work shall conform to the requirements of the following standards where applicable:

1. AISC Specifications and NAAMM Standards.
2. ASTM American Society of Testing Materials Specifications.
3. AWS Specification for Welding in Building Construction of the American Welding Society.

E. All arc-welding electrodes shall conform to ASTM A-233 for Steel Arc-Welding Electrodes. Electrodes shall be as recommended by their manufacturers for the positions and other conditions of actual use.

F. Workmanship: All sections shall be well formed to shape and size with sharp lines and angles. Shearing and punching shall leave clean and true surfaces. Care shall be taken that shapes and plates are free from waves, kinks and bends.

G. Fabrication: Unless otherwise shown or specified, fabricate steel items in accordance with the details on the drawings and the AISC Specification.

PART 2 – PRODUCTS

2.1 STEEL GUARD POST BOLLARDS

A. Steel guard post bollards shall be 6 inch diameter standard galvanized steel pipe filled with and set in concrete. Bollards shall extend 54 inches above finished grade and be set at least 36 inches below finished grade in a minimum 24 inch diameter concrete footing.

2.2 TRASH AREA GATES

A. General: Fabricate trash area gates framed of hot dip galvanized steel tube; 3x2x1/4 frame with horizontal mid rail and diagonal bracing to receive prefinished metal cladding. Gates shall be complete with hot dip galvanized steel tube jamb posts filled with concrete and set in 18 inch diameter reinforced concrete piers, complete with welded on pin type hinges, latches and 3/4 inch cane bolts with 6 inch deep standard pipe sleeves in concrete for cane bolts in both the open and closed position with holder for the up position. Field paint all galvanized steel. Equip hinges with grease zerks as required to lubricate.

2.3 MISCELLANEOUS

A. Other miscellaneous steel components required by the drawings shall be fabricated of sections, thicknesses, lengths and configurations as shown on those drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all items specified herein unless otherwise noted; all true, square, plumb and accurately fitted. The Contractor shall be responsible for locations and levels of all work of this section.

B. Make provision for connections of other work where indicated by drawings or where information is furnished prior to or at time of approval of shop drawings.

C. Remove scale, rust and other deleterious materials, then immediately prime paint, fully covering joints, corners, edges and exposed surfaces.

D. Grind edges and corners smooth, where subject to contact by persons or moving items.

E. Fill protective bollards and trash area gate hinge posts with concrete.

END OF SECTION 055000

SECTION 055113 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings and guards attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs, railings, and guards.

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, blocking for attachment of wall-mounted handrails, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.

D. Schedule installation of railings and guards so wall attachments are made only to completed walls.

1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and the following:

1. Shop primer products.
2. Nonslip-aggregate concrete finish.
3. Abrasive-coating finish to formed-metal stairs.
4. Handrail wall brackets.
5. Grout.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

C. Delegated-Design Submittal: For stairs, railings, and guards, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

a. Repair or replace damaged materials or structures as directed.

PART 2 - <u>PRODUCTS</u>

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, railings, and guards, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft.
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

    a. Uniform load of 50 lbf/ft. applied in any direction.
    b. Concentrated load of 200 lbf applied in any direction.
    c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

    a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    b. Infill load and other loads need not be assumed to act concurrently.

3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

    a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.

2.2 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed) or ASTM A513/A513M.

1. Provide galvanized finish for exterior installations and where indicated.

D. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

E. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.

F. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls.

1. Select fasteners for type, grade, and class required.

B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.

C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs.

E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

A. Handrail Wall Brackets: Cast aluminum or cast stainless steel, center of rail 2-1/2 inches from face of wall.

1. Wagner #4591 Iron wall brackets.
2. Wagner #140 5/8” dia bend bar w/ #S101 Saddle railing brackets.

B. Welding Electrodes: Comply with AWS requirements.

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Zinc-Rich Primer: Comply with SSPC-Paint 20, Type I-A, Level 1, and compatible with topcoat.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

F. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

G. For galvanized reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings and guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs, railings, and guards in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 - Completely sanded joint with some undercutting and pinholes okay.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that will be exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Commercial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel plates or steel channels or steel rectangular tubes as indicated on Drawings.

    a. Stringer Size: As required to comply with "Performance Requirements" Article.
    b. Provide closures for exposed ends of channel and rectangular tube stringers.
    c. Finish: Shop primed.

2. Construct platforms of steel plate or channel or rectangular tube headers and miscellaneous framing members as required to comply with "Performance Requirements" Article and indicated on Drawings.

    a. Provide closures for exposed ends of channel and rectangular tube framing.
    b. Finish: Shop primed.

3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below.

    a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.

1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
2. Steel Sheet: Uncoated, cold or hot-rolled steel sheet unless otherwise indicated.
3. Steel Sheet: Galvanized-steel sheet, where indicated.
4. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
5. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
6. Shape metal pans to include nosing integral with riser.
7. Attach abrasive nosings to risers.
8. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
9. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

    a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.7 FABRICATION OF STAIR RAILINGS AND GUARDS

A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings."

B. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: 1-1/2-inch-diameter top and bottom rails and 1-1/2-inch-square posts.
2. Picket Infill: 1/2-inch-round pickets spaced to prohibit the passage of a 4-inch diameter sphere.

C. Welded Connections: Fabricate railings and guards with welded connections.

1. Fabricate connections that are exposed to weather in a manner that excludes water.

a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
3. Weld all around at connections, including at fittings.
4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Remove flux immediately.
7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2- Completely sanded joint, some undercutting and pinholes are okay as shown in NAAMM AMP 521.

D. Form changes in direction of railings and guards as follows:

1. As detailed.
2. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.

E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

F. Close exposed ends of railing and guard members with prefabricated end fittings.

G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

H. Connect posts to stair framing by direct welding unless otherwise indicated.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
2. For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.

3. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
4. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.

1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

A. Finish metal stairs after assembly.

B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.

a. Clean bottom surface of plates.
b. Set plates for structural members on wedges, shims, or setting nuts.
c. Tighten anchor bolts after supported members have been positioned and plumbed.
d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

1. Float in aluminum grit on all treads to be left exposed, per manufacturer’s instructions.
2. Center nosings on tread width.

3.3 INSTALLATION OF RAILINGS AND GUARDS

A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
4. Secure posts, rail ends, and guard ends to building construction as follows:

a. Anchor posts to steel by welding or bolting to steel supporting members.
b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.

B. Attach handrails to wall with wall brackets.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
2. Secure wall brackets to building construction as required to comply with performance requirements.

a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
b. For hollow masonry anchorage, use toggle bolts.

c. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

d. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

3.4 REPAIR

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION 055113

SECTION 055213 PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum pipe and tube railings.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aluminum Pipe and Tube Railings:

a. Balcony railings shall be mechanically fastened powder coated aluminum railings with 3 inch posts, color to be confirmed after submission of sample railing.

b. Interior stair handrail and guard railings, balusters and pickets.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt or predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.4 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Tubing: ASTM B 221, Alloy 6063-T5/T52.

C. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

D. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832

E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.

G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.5 FASTENERS

A. General: Provide the following:

1. Aluminum Railings: Type 304 stainless-steel fasteners.

B. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 09 Painting Section.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 FABRICATION

A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Form work true to line and level with accurate angles and surfaces.

C. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

D. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

E. Form changes in direction by bending or by inserting prefabricated elbow fittings.

F. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

G. Close exposed ends of railing members with prefabricated end fittings.

H. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

   1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

2.8 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

3.2 ANCHORING POSTS

A. Anchor posts to concrete by method recommended by railing manufacturer.

3.3 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets at spacing required to support structural loads.

B. Attach handrails to walls with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

C. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

3.4 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 Painting Section.

3.5 CLEANING

A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

SECTION 061000 ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all Rough Carpentry Work, complete and in place, as shown on the Drawings and as specified herein.

1.2 MEASUREMENTS

A. Verify all dimensions shown on Drawings by taking field measurements; proper fit and attachment of all parts is required. Before starting Work, check all lines and levels indicated and such other Work as has been completed. Should there be any discrepancies, immediately report to Architect.

1.3 COORDINATION

A. Coordinate Work with all other trades (Electrical, Mechanical, Plumbing, etc.) and do all cutting and patching required to accommodate their Work. Protect all adjacent Work.

1.4 DELIVERY AND STORAGE

A. As per GENERAL CONDITIONS, deliver and store lumber on sills and cover for protection. Ensure ventilation and drainage; protect against weather and damage. Keep all materials clearly identified, with all grade marks legible

1.5 WOOD BACKINGS

A. Provide all wood backing, furring, stripping or blocking indicated or required for installation and attachment of Work of all other trades. Cut and frame all openings required by other trades. Structural members shall not be cut, notched or drilled, except as may be shown or noted on Drawings

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rough carpentry materials shall be as follows (unless otherwise noted on the Structural Drawings):

1. Sills & Bottom Plates in contact with concrete shall be 2x4, 2x6, & 2x8, Pressure Preservative Treated DF or SP, Grade as noted on the Drawings.
2. Top Plates and Studs shall be 2x4, 2x6, & 2x8 #2 Grade DF or SP as noted on the Drawings.
3. Headers, Joists & Rafters shall be sizes indicated #2 DF.
4. Special Headers shall be as indicated Laminated Veneer Lumber (LVL), or Parallam

Parallel Strand Lumber (PSL).

5. Miscellaneous Studs, Blocking, Etc. shall be 2x4 & 2x6 #3 DF or SP.
6. Floor Sheathing shall be 23/32" thick T&G APA Rated CD grade plywood.
7. Roof Sheathing shall be 15/32"or 19/32" thick APA Rated Exterior Grade Sheathing.
8. Exterior Wall Sheathing shall be 7/16" thick APA Rated OSB wall sheathing.
9. Plywood at the Balcony Floors shall be 15/32" thick pressure treated plywood.
10. Exterior Posts, Beams, and joists shall be as indicated Pressure Preservative Treated.
11. Rough hardware shall include all nails, bolts, clip angles, plates, etc. required for all rough and exterior finish carpentry. All joist hangers and miscellaneous metal connectors shall be Simpson Strong-Tie, Kant-Sag, EFI or approved equal. Exterior hardware and fasteners and fasteners shall be galvanized.
12. Refer to Structural Drawings for additional information.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Carpentry methods and procedures shall be as follows:

1. Mudsills shall be pressure preservative treated, bolted to foundation wall with sill sealer, as noted on drawings.
2. Roof trusses shall be 24" o.c. maximum, doubled and tripled as indicated or required and sloped or vaulted as indicated.
3. Floor trusses shall be 24" o.c. maximum, doubled and tripled as indicated or required and have crown at top.
4. Truss bracing and bridging shall be located as indicated on the plans or as required by truss manufacturer.
5. Stud wall sole plates shall be securely anchored to floor or slab. Double top plates.
6. Exterior studs shall be 16" o.c. maximum; spaced for openings, and doubled at openings, and tripled at corners and as indicated on the Structural drawings.
7. Interior studs shall be 16" o.c. maximum; spaced for doors and ducts; doubled at openings, and tripled at corners and as indicated on the Structural drawings.
8. Provide solid blocking under all headers, beams, doubled trusses, etc. bearing on stud walls.
9. Wind brace all exterior walls as indicated on the drawings.
10. Wood beams shall be set true, plumb, level to provide tight joints at connections over solid, full width blocking at all points of beam bearing.
11. Fire stop all common walls at floor and plate lines.
12. Install roof deck and subfloor with face grain perpendicular to supports. Terminate panels over supports. Stagger end joints of adjacent panels 4'-0".

    a. Allow 1/16" between end joints and 1/8" between edge joints for expansion and contraction.
    b. Lay glue bead on each joist for glue and nail construction. Install in accordance with manufacturer's product data.
    c. Attach sheathing with 8d nails or #10 screws spaced at 6" o.c. along panel edges and 12" along intermediate supports.
    d. Install plywood edge clips at all unsupported edges.

13. Position wall sheathing over exterior studs with long dimension vertically and 1/8" between sheets for expansion.
14. Glue and nail subfloor to joists.
15. Fire stop all party walls and chases at floor and plate lines.
16. All wood framing within the same plane shall be connected with Simpson, Kant-Sag or EFI connectors.
17. All exterior walls shall receive one layer of Weather Barrier as specified in DIVISION 7.
18. Space all joists and trusses as required for exact location of recessed light fixtures as indicated, i.e., light fixtures will center over windows, sinks, etc.
19. Roof sheathing shall be installed in strict accordance with the roofing manufacturer's specifications for roof decks.
20. Provide solid blocking as indicated for current of future grab bar installation in all bathrooms and restrooms. Provide solid blocking 2x4 or 2x6 to receive towel bars or toilet paper holders as indicated in all apartment bathrooms. Provide solid blocking at all TV locations indicated for attachment of wall mounted TVs.

END OF SECTION 061000

SECTION 061753 SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood roof trusses.
2. Wood floor trusses.
3. Wood girder trusses.
4. Wood truss bracing.
5. Metal truss accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.

B. Shop Drawings: Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
2. Indicate sizes, stress grades, and species of lumber.
3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
6. Show splice details and bearing details.

C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Evaluation Reports: For the following, from ICC-ES:

1. Metal-plate connectors.
2. Metal truss accessories.

1.4 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.

1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations in TPI BCSI**,** "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design metal-plate-connected wood trusses. Shop drawings, plan placement drawings, and structural analysis data shall be signed and sealed by the qualified professional engineer responsible for their preparation. Engineer shall be licensed in the state of Missouri.

B. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.

2.2 DIMENSION LUMBER

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

B. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

2.3 METAL CONNECTOR PLATES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alpine Engineered Products, Inc.; an ITW company.

2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
3. CompuTrus, Inc.
4. Eagle Metal Products.
5. Jager Building Systems, Inc.; a Tembec/SGF Rexfor company.
6. MiTek Industries, Inc.; a subsidiary of Berkshire Hathaway Inc.
7. Robbins Engineering, Inc.
8. Truswal Systems Corporation; an ITW company.

B. General: Fabricate connector plates to comply with TPI 1.

C. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
2. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.
3. Phoenix Metal Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. USP Structural Connectors.

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

2.6 FABRICATION

A. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

B. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to TPI recommendations and as indicated.

E. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.

F. Securely connect each truss ply required for forming built-up girder trusses.

G. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

H. Install bracing to comply with Section 061000 "Rough Carpentry."

1. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

I. Install wood trusses within installation tolerances in TPI 1.

J. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

K. Replace wood trusses that are damaged or do not meet requirements.

END OF SECTION 061753

SECTION 062000 FINISH CARPENTRY & MILLWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all Finish Carpentry and Millwork, complete and in place, as shown on the Drawings and as specified herein.

1.2 MEASUREMENTS

A. Verify all dimensions shown on Drawings by taking field measurements; proper fit and attachment of all parts is required. Before starting Work, check all lines and levels indicated and such other Work as has been completed. Should there be any discrepancies, immediately report to the Architect.

1.3 COORDINATION

A. Coordinate Work with all other trades (Electrical, Mechanical, Plumbing, etc.) and do all cutting and patching required to accommodate their Work. Protect all adjacent Work.

1.4 DELIVERY AND STORAGE

A. As per GENERAL CONDITIONS, deliver and store materials protected against weather and damage.

1.5 SUBMITTALS

A. The Contractor shall prepare and submit to the Architect, shop drawings of all millwork items. Contractor shall verify all dimensions at the job site.

1.6 FABRICATION

A. Employ skilled craftsmen to carefully fabricate the Work of this Section in strict accordance with the original design and the approved Shop Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Finish carpentry and millwork materials shall be as follows (unless otherwise noted on the drawings):

1. Horizontal Lap Siding: See Section 074646 “Fiber-Cement Siding” for fiber-cement siding and soffits.

2. Vertical Board and Batten Pattern: See Section 074646 “Fiber-Cement Siding” for fiber-cement siding and soffits.

3. Window stools in the apartments shall be primed wood, 3/4-inch-thick x length and width required with eased outside edges.

4. Apartment millwork trim shall be paint grade pine. Trim may be finger-jointed and factory primed at the Contractor's option.

PART 3 - EXECUTION

3.1 METHODS AND PROCEDURES

A. Finish carpentry methods and procedures shall be as follows:

1. Conditioning: Installer shall advise Contractor of temperature and humidity requirements for finish carpentry installation areas. Do not install finish carpentry until required temperature and relative humidity conditions have been stabilized and will be maintained in installation areas.

2. Install no interior finish carpentry or millwork until spaces are enclosed, dry, and capable of being heated. Maintain temperature between 55 F. and 75 F. for 72 hours before beginning installation and for duration of project.

3. Field Measurements: Take field measurements to determine exact millwork sizes. Indicate exact dimensions on shop drawings.

4. Lumber for Transparent Finish (Stained or Clear): Use pieces made of solid lumber stock.

5. Lumber for Painted Finish: At Contractor's option, use pieces which are either glued-up or made of solid lumber stock.

6. Discard units of material which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned or too small to fabricate work with minimum of joints or optimum jointing arrangements, or which are defectively manufactured with respect to surfaces, sizes or patterns.

7. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims.

8. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

9. Finish work shall be smooth, free from abrasion, tool marks, raised grain markings, or similar defects on exposed surfaces.

10. Anchor finish carpentry work to anchorage devices or blocking built in or directly attached to substrates. Secure to grounds, striping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinishing matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with finished surface, and matching final finish where transparent is indicated.

11. Standing and running trim installation as follows:

a. Trim and mouldings: Install in single, unjointed lengths for openings and for runs less than 10'-0" long in longer straight runs. Stagger joints in adjacent members. Cope at returns and miter at corners.

b. Attach and secure in place with uniform joints providing for thermal and building movements.
c. Nailing: Blind nail where possible. Use finishing nails where exposed. Set exposed nail heads for filling.
d. Anchoring: Secure work to anchors or blocking built in or directly attached to substrate.
e. Stagger joints in adjacent and related members. Cope at returns, miter at corners, to produce tight fitting joints with full surface contact throughout length of joint.

12. Mill shall verify field dimensions before commencing any cabinetry work. Cabinetry shall be carefully fitted and securely fastened in place.

13. Mitered joints are required in all casings and running trim. All trim not terminating at an inside corner including window stools and aprons shall have mitred returns to wall. No butt cuts shall be acceptable.

14. All work shall be first class in every way and installed in strict accordance with all manufacturer's instructions.

15. Adjustment, cleaning, finishing and protection:

a. Repair damaged and defective finish carpentry work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork. Adjust jointery for uniform appearance.
b. Clean finish carpentry work on exposed and semi-exposed surfaces. Touch-up shop applied finishes to restore damaged or soiled areas.
c. Protection: Installer of finish carpentry work shall advise contractor of final protection and maintained conditions necessary to ensure that work will be without damage or deterioration at time of acceptance.

END OF SECTION 062000

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Modified bituminous sheet waterproofing.
2. Protection course.
3. Molded-sheet drainage panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING – FOUNDATIONS

A. Modified Bituminous Sheet Waterproofing: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Tamko Building Products, Inc; TW-60.
   b. W.R. Meadows, Inc; Mel-Rol.

2. Physical Properties:

   a. Tensile Strength, Membrane: 250 psi minimum; ASTM D412, Die C, modified.
   b. Ultimate Elongation: 300 percent minimum; ASTM D412, Die C, modified.
   c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
   d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C836/C836M.
   e. Puncture Resistance: 40 lbf minimum; ASTM E154/E154M.
   f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D570.
   g. Water Vapor Permeance: 0.05 perm maximum; ASTM E96/E96M, Water Method.
   h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D5385.

3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING – BALCONIES

A. Modified Bituminous Balcony Sheet Waterproofing: Minimum 60-mil nominal thickness, self-adhering sheet; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Polyguard Products Inc; Polyguard Balconyguard Membrane.
   b. Tamko Building Products, Inc: TW-60.
   c. W.R. Meadows, Inc: Mel-Rol.

2. Physical Properties:

   a. Tensile Strength, Membrane: 250 psi minimum; ASTM D412, Die C, modified.
   b. Ultimate Elongation: 300 percent minimum, ASTM D412, Die C, modified.
   c. Low-Temperature Flexibility: Pass at minus 20 deg F: ASTM D1970/D1970M.
   d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C836/C836M.
   e. Puncture Resistance: 40 lbf minimum: ASTM E154/E154M.
   f. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D5385.

3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid solvent-borne primer recommended for substrate by sheet-waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.

G. Protection Course, Asphaltic: ASTM D6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:

1. Thickness: Nominal 1/4 inch.
2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection course type.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft.

1. Products: Subject to compliance with requirements, provide one of the following:

a. American Hydrotech, Inc.; Hydrodrain 400.
b. Carlisle Coatings & Waterproofing Inc; Carlisle Construction Materials; CCW MiraDRAIN 6200.
c. CETCO; Aquadrain 15XP.
d. GCP Applied Technologies Inc.; Hydroduct 220.
e. ISI Building Products; AquaCheck DB 1500.
f. Polyguard Products, Inc.; Polyflow 10-P.
g. Urethane Polymers International, Inc.; EZE-DRAIN V-2.

B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel without Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core, without a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft.

1. Products: Subject to compliance with requirements, provide one of the following:

a. American Hydrotech, Inc.; Hydrodrain 420.
b. Carlisle Coatings & Waterproofing Inc; Carlisle Construction Materials; CCW MiraDRAIN 6000.
c. CETCO; Aquadrain 10X.
d. GCP Applied Technologies Inc.; Hydroduct 200.
e. ISI Building Products; AquaCheck DB 1000.
f. Polyguard Products, Inc.; Polyflow 10 for vertical surfaces.
g. Polyguard Products, Inc.; Polyflow BD for balconies.
h. Soprema, Inc.; Sopradrain 10G.
i. Urethane Polymers International, Inc.; EZE-DRAIN V.
j. W.R. Meadows, Inc; Mel-Drain.

C. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel without Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 sieve, laminated to one side of the core, without a polymeric film bonded to the other side; and with a horizontal flow rate through the core of not less than 2.8 gpm per ft.

1. Products: Subject to compliance with requirements, provide one of the following:

a. American Hydrotech, Inc.; Hydrodrain 700.
b. Carlisle Coatings & Waterproofing Inc; Carlisle Construction Materials; CCW MiraDRAIN 9000.
c. CETCO; Aquadrain 20H.
d. Polyguard Products, Inc.; Polyflow 18.
e. Soprema, Inc.; Sopradrain 18G.
f. Urethane Polymers International, Inc.; EZE-DRAIN HD.
g. W.R. Meadows, Inc; Mel-Drain.

2.5 INSULATION DRAINAGE PANELS

A. Insulation: Comply with Section 072100 "Thermal Insulation" for general building insulation.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

3.2 INSTALLATION OF MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.

E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

F. Seal edges of sheet-waterproofing terminations with mastic.

G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

I. Immediately install protection course with butted joints over waterproofing membrane.

3.3 INSTALLATION OF MOLDED-SHEET DRAINAGE-PANELS

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.4 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot traffic on unprotected membrane.

B. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071326

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Polyurethane waterproofing.
2. Molded-sheet drainage panels.
3. Insulation drainage panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including, but not limited to, the following:

a. Surface preparation specified in other Sections.
b. Minimum curing period.
c. Forecasted weather conditions.
d. Special details and sheet flashings.
e. Repairs.
f. Field quality control.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings:

1. Indicate locations and extent of waterproofing.
2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

C. Samples: For each exposed product and for each color and texture specified, including the following products:

1. Flashing sheet, 8 by 8 inches.
2. Membrane-reinforcing fabric, 8 by 8 inches.
3. Drainage panel, 4 by 4 inches.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A manufacturer-approved firm with minimum three years experience in installation of specified products in successful use on similar projects, employing workers trained by manufacturer, including a full-time on-site supervisor with a minimum of three years experience installing similar work, and able to communicate verbally with Contractor, Architect, and employees.

B. Manufacturer Qualifications: A qualified manufacturer, with minimum five years experience in manufacture of waterproofing as one of its principal products. Shall also have local rep available for field inspections at the beginning of project to verify compliance with manufactures installation requirements.

1. Manufacturer's product submitted has been in satisfactory operation on five similar installations for at least five years.
2. Approval of Manufacturers and Comparable Products: Prime bidder must submit the following in accordance with project substitution requirements, within time allowed for substitution review:

a. Completed and signed Substitution Request form.
b. Product data, including certified independent test data indicating compliance with requirements.
c. Sample shop drawings from similar project.
d. Project references: Minimum of five installations of similar system not less than five years old, with Owner and Architect contact information.
e. Name and resume of proposed qualified Inspector.
f. Sample warranty.

A. Waterproofing Inspector Qualifications: An independent party certified as a waterproofing inspector by the SWRI or other certifying organization acceptable to Architect, retained by the Contractor and experienced in the installation and maintenance of the specified waterproofing system, qualified to perform observation and inspection specified in Field Quality Control Article, to determine Installer’s compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification.

B. Testing Agency Qualifications: Qualified independent agency experienced in the installation of the specified waterproofing system, and qualified to perform observation and inspection specified in Field Quality Control Article to determine Installer’s compliance with the requirements of this Project, acceptable to Architect, retained by the Contractor.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build mockup for each typical waterproofing installation, including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.

    a. Size: 150 sq. ft. in area.
    b. Description: Each type of installation.
    c. Include examples of surface preparation, crack and joint treatment, wall-footing junctures, wall corners, horizontal and vertical piping sleeving and conduit, deck drains and other similar penetrations, waterproofing application, and flashing, transition, and termination conditions, to set quality standards for execution.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.

1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.
2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain waterproofing materials from single source and from single manufacturer.

2.2 POLYURETHANE WATERPROOFING

A. Single-Component, Modified Polyurethane Waterproofing: ASTM C836/C836M and coal-tar free.

1. Products: Provide waterproofing products manufactured by Tremco, Inc., Commercial Sealants and Waterproofing Division, Beachwood OH; (866) 321-6357; email: techresources@tremcoinc.com; www.tremcosealants.com, Local Rep: Patrick Geraghty, (913) 226-1941, comparable products of other manufacturer meeting performance requirements.

a. Tremco Incorporated; TREMproof 250 GC.

1) VOC Content: Less than 100 g/L, roller and self-leveling grades.
2) VOC Content: Less than 160 g/L, trowel detailing grade.
3) Water Vapor Permeance: 0.03 perm, maximum, ASTM E96/E96M.
4) Hardness, ASTM D 2240: 70 – 80.
5) Low Temperature Flexibility and Crack Bridging, ASTM C 1305: Pass.
6) Adhesion in Peel, ASTM C 794: 26 lbf/in. (4553 N/m).
7) Thickness: One coat 60 mils for vertical walls.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated.

C. Sheet Flashing: 50-mil-minimum, nonstaining, uncured sheet neoprene.

1. Adhesive: Manufacturer's recommended contact adhesive.

D. Membrane-Reinforcing Fabric: Manufacturer's recommended fiberglass mesh or polyester fabric, manufacturer's standard weight.

E. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

F. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; ASTM C920, Type M, Class 25 or greater; Grade NS for sloping and vertical applications and Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam.

2.4 MOLDED-SHEET DRAINAGE PANELS (PROVIDE AT ALL LOCATIONS WHERE WATERPROOFING INSTALLED)

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core, without a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft.

1. Products: Subject to compliance with requirements, provide one of the following:

a. American Hydrotech, Inc.; Hydrodrain 420.
b. Carlisle Coatings & Waterproofing Inc; Carlisle Construction Materials; CCW MiraDRAIN 6000XL.
c. W.R. Meadows, Inc; Mel-Drain.

2.5 INSULATION

A. Insulation: Comply with Section 072100 "Thermal Insulation" for general building insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates in accordance with manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate in accordance with ASTM D4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces in accordance with ASTM D4258.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners in accordance with waterproofing manufacturer's written instructions and to recommendations in ASTM C898/C898M and ASTM C1471/C1471M.

B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate in accordance with waterproofing manufacturer's written instructions and to recommendations in ASTM C898/C898M and ASTM C1471/C1471M. Before coating surfaces, remove dust and dirt from joints and cracks in accordance with ASTM D4258.

1. Comply with ASTM C1193 for joint-sealant installation.
2. Apply bond breaker on sealant surface, beneath preparation strip.
3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

B. Install sheet flashing and bond to deck and wall substrates where required in accordance with waterproofing manufacturer's written instructions.

1. Extend sheet flashings for 4 inches onto perpendicular surfaces and items penetrating substrate.

3.5 INSTALLATION OF WATERPROOFING

A. Apply waterproofing in accordance with manufacturer's written instructions and to recommendations in ASTM C898/C898M and ASTM C1471/C1471M.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 60 mils.
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft.

E. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

3.6 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, in accordance with manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install thermal insulation specified in Section 072100 "Thermal Insulation" before installing drainage panels.

B. Molded-Sheet Collector-Panel System: Install in accordance with manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, and drainage components and to furnish reports to Architect.

3.8 PROTECTION

A. Do not permit foot traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

END OF SECTION 071416

SECTION 072100 BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Supply and install all Insulation Work as shown on the Drawings and as specified herein.

1.2 COORDINATION

A. Check Work of other Trades which abuts, adjoins or is affixed by Work under this Section. Consult Drawings and other Sections and expedite and coordinate Work to avoid omissions and delays.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All batt insulation shall be the product of Owens/Corning Fiberglas or equal.

B. Batt insulation in all 2x6 exterior walls shall be 5-1/2-inch thick, R-21, Kraft faced fiberglass batts as required to fill the stud space.

C. Rim board insulation shall be R-21 unfaced fiberglass batts.

D. Attic insulation shall be blown-in fiberglass insulation of the thickness required to achieve an R-50 rating.

E. Floor truss cavities at cantilevered bays shall be filled with blown-in fiberglass insulation to achieve a minimum R-50 rating.

F. Spray foam insulation shall be code approved, low-expanding, low-pressure polyurethane foam sealant as manufactured by BASF or approved equal.

G. Sound control batt insulation in both walls of partitions separating apartment units as well as corridor, stairway, all unit ceilings with units above and all walls and ceilings indicated to receive acoustical batt insulation shall be 3-1/2-inch-thick, R-11 fiberglass sound attenuation insulation.

H. Sill sealer shall be ProPink ComfortSeal, 3-1/2-inch or 5-1/2-inch wide by 1/4-inch-thick polyethylene sill plate gasket as manufactured by Owens Corning, or Styrofoam Brand Sill Seal by Dupont.

I. Slab edge insulation shall be as indicated, Styrofoam Brand Square Edge extruded polystyrene foam insulation as manufactured by Dow Chemical Co. or approved equal. Two inch thick, R-10 at patios, and one inch thick, R-5 at brick veneer.

J. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized

to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. The drawings and specifications give general information as to areas to receive thermal insulations. However, there will be areas not shown or described where insulations will obviously be necessary, and occasionally drawing details are shown without the insulation, for clarity of the detail. Therefore, irrespective of any omissions of detail or description, for every area where heat losses and vapor transmissions can occur between heated and non-heated spaces, Contractor shall provide insulation and vapor barrier cutoff equal to other similar installations in the building and as necessary to provide a completely insulated and vapor resistant installation.

C. Cut blankets to length, tightly fitting between framing. Face vapor barriers to winter warm side. Fill small spaces with cut sections, packing every space where heat losses can occur.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. All mud sills shall be set on sill sealer.

F. Fill voids at rough openings of all doors and windows, and other penetrations with expanding open cell spray foam insulation, with low expansion force.

G. Comply with manufacturer's instructions for particular conditions of installation in each case.

H. Insulation Contractor shall provide means of protecting recessed lighting in attic space from coming in contact with insulation. This protection should be in the form of a framed surround at each fixture to keep insulation from touching fixture and consequently avoid overheating.

I. Set vapor barrier faced units with vapor barrier to winter warm side of construction, except as otherwise shown. Do not obstruct ventilation spaces, except for fire-stopping.

J. See Division 07, Section "Weather Barriers" for building wrap.

3.2 GREEN BUILDING INSTALLATION PRACTICES

A. Provide Grade I insulation installations. Grade I insulation installations are in accordance with the following:

1. Grading applies to field-installed insulation products.

2. Grading applies to ceilings, walls, floors, band joists, rim joists, conditioned attics, basements, and crawlspaces, except as specifically noted.

3. Inspection is conducted before insulation is covered.

4. Air-permeable insulation is enclosed on all six sides and is in substantial contact with the sheathing material on one or more sides (interior and exterior) of the cavity. Air permeable insulation in ceilings is not required to be enclosed when the insulation is installed in substantial contact with the surfaces it is intended to insulate.

5. Cavity insulation uniformly fills each cavity side-to-side and top-to-bottom, without substantial gaps or voids around obstructions (such as blocking or bridging).

6. Cavity insulation compression or incomplete fill amounts to 2 percent or less, presuming the compressed or incomplete areas area a minimum of 70 percent of the intended fill thickness; occasional small gaps are acceptable.

7. Exterior rigid insulation has substantial contact with the structural framing members or sheathing materials and is tightly fitted at joints.

8. Cavity insulation is split, installed, and/or fitted tightly around wiring and other services.

9. Exterior sheathing is not visible from the interior through gaps in the cavity insulation.

10. Faced batt insulation is permitted to have side-stapled tabs, provided the tabs are stapled neatly with no buckling, and provided the batt is compressed only at the edges of each cavity, to the depth of the tab itself.

11. Where properly installed, ICFs, SIPs, and other wall systems that provide integral insulation are deemed in compliance with the Grade 1 insulation installation requirements.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For wood-framed construction, install blankets according to ASTM C1320 and as follows:

    a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

END OF SECTION 072100

SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Weather barrier assemblies.
2. Building wrap.
3. Weather barrier flashing.
4. Flexible flashing.
5. Fluid applied flashing.
6. Weather barrier accessories.
7. Drainage material.

B. Related Requirements:
1. Section 044313.19 "Adhered Masonry Veneer" for thin brick.
2. Section 072100 "Thermal Insulation" for installation of exterior insulation.
3. Section 074646 "Fiber-Cement Siding" for installation of fiber-cement board siding.

1.2 DEFINITIONS

A. Weather Barrier: A combination of materials and accessories that do the following:

1. Prevents the accumulation of water as a water-resistive barrier.
2. Minimizes the air leakage into or out of the building envelope as a continuous air barrier.
3. Provides sufficient water vapor transmission to enable drying as a vapor-permeable membrane.

B. Water-Resistive Barrier: A combination of materials and accessories that prevent the accumulation of water within the wall assembly per International Building Code Section 1403.2.

C. Continuous Air Barrier: The combination of interconnected materials, assemblies, and sealed joints and components of the building envelope that minimize air leakage into or out of the building envelope per ASHRAE 90.1 section 5.4.3.1.

D. Vapor Diffusion: A slow movement of individual water vapor molecules from regions of higher to lower water vapor concentration (higher to lower vapor pressure).

E. Vapor Permeable Membrane: The property of having a water-vapor permeance rating of 10 perms (575 ng/Pa x s x sq. m) or greater, when tested in accordance with the desiccant method using Procedure A of ASTM E 96 per definition in International Building Code. Vapor permeable material permits the passage of moisture vapor through vapor diffusion.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Manufacturer's Certified Installer, weather barrier manufacturer's designated field representative, and installers of work that interfaces with or affects weather barrier.
2. Review methods and procedures related to weather barrier installation, including manufacturer's written instructions, fastener types and spacings, etc.
3. Review and finalize construction, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine substrate conditions and finishes for compliance with requirements.
5. Review flashings, special weather barrier details, weather barrier penetrations, and condition of other construction that affects weather barrier.
6. Review weather barrier manufacturer's Project Warranty Registration and Observation process.
7. Review Construction Indoor Air Quality Management Plan "Moisture Protection for Absorbent Materials."
8. Review temporary protection requirements for weather barrier during and after installation, including repair techniques for repairing damaged areas.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is certified by weather barrier system manufacturer to install manufacturer's product.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assemblies of each substrate type and covering material, approx., 150 sq. ft. each, incorporating backup wall construction, external cladding, one window, storefront, door frame and sill, insulation, ties, conduit and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of weather barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

    a. Include junction with roofing membrane, building corner condition, and foundation wall intersection, fenestration and wall interface.
    b. Water test exterior wall with water spray apparatus for 15 minutes and check for leaks inside.
    c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply weather barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Manufacturer's Field Service: Register project with weather barrier manufacturer prior to installation of weather barrier and comply with weather barrier manufacturer's Project registration and observation process.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store near heat source or open flame.

1.6 WARRANTY

A. Manufacturer's Product Warranty: To repair or replace weather barrier product that fails in materials within specified warranty period.

1. Warranty Period: 10 years from date of purchase.

B. Manufacturer's Product and Labor Warranty: Manufacturer agrees to repair or replace weather barrier that fails in materials within specified warranty period, including removal and replacement of affected construction up to manufacturer’s limits.

1. Warranty Period: 10 years from date of purchase.

1.7 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

B. Shop Drawings: Show details of building wrap at terminations, openings, and penetrations. Show details of flexible flashing applications.

1.8 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

B. Manufacturer's Instructions: For installation of each product specified.

C. Qualification Data: For Installer, laboratory, mockup testing agency, and field testing agency.

D. Sample Warranty: For manufacturer's warranty.

E. Reports: Field test and inspection reports.

F. Installer's weather barrier manufacturer-training certificate.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain weather barrier assembly components, including weather barrier flashing and foam insulation from same manufacturer as weather barrier or manufacturer approved by weather barrier manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed weather barrier and accessories shall withstand specified wind pressures, liquid water penetration, and water vapor pressures, without failure due to defective manufacture of products, per the International Building Code and as noted on the Structural Drawings.

B. High-Performance Installations:

1. For installation with one of the following building envelope performance or structural characteristics:

    a. Exceeding 65 mph (100 km/h) equivalent structural load.
    b. Exceeding 15 mph (24 km/h) equivalent wind-driven rainwater infiltration.
    c. Buildings with 60 feet (18 m) or more total height above grade plane, as defined in the International Building Code.
    d. Construction with gypsum or cement-based exterior sheathing.
    e. Non-wood based primary structure such as: steel, light gage steel, masonry or concrete.

2.3 WEATHER BARRIER

A. Building Wrap: ASTM E1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide the following:

    a. DuPont de Nemours, Inc.; DuPont™ Tyvek® CommercialWrap® D.

        1) System Description, Single-Layer Drainable: Single-layer weather barrier with integral drainage, including flashing and sealing of penetrations and seams.

            a) Primary Layer: Commercial building wrap "D" with integral drainage installed closest to building interior.

2. Water-Vapor Permeance: Not less than 23 perms per ASTM E96/E96M, Desiccant Method (Procedure A).
3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg when tested according to ASTM E2178.
4. Allowable UV Exposure Time: Not less than three months.
5. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.4 WEATHER BARRIER FLASHING

A. Conformable Weather Barrier Flashing: Composite flashing material composed of micro-creped, polyethylene laminate with a 100 percent butyl-based adhesive layer; AAMA 711 Class A (no primer), Level 3 thermal exposure, 176 deg F (80 deg C) for 7 days.

1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: E. I. du Pont de Nemours and Company; FlexWrap™ NF or comparable product by Architect approved manufacturer.
2. Conformability: Able to create a seamless sill pan extending up the jambs without cuts, patches, or fasteners.
3. Water Penetration: No leakage at 15 psf (720 Pa) per ASTM E 331.
4. Low Temperature Adhesion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm) at 25 degrees F (minus 4 deg C) as Class A (without primer use).

5. Adhesion After Water Immersion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm), after AAMA 800, Sections 2.4.1.3.1/2.4.1.4.3, Test B.

B. Strip Flashing: Composite flashing material composed of spunbonded polyethylene laminate with 100 percent butyl-based, dual-sided, adhesive layer; AAMA 711, Class A (no primer), Level 3 thermal exposure, 176 deg F (80 deg C) for 7 days.

1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: E. I. du Pont de Nemours and Company; StraightFlash™ and StraightFlash™ VF for non-flanged windows and like assemblies or comparable product by Architect approved manufacturer.
2. Water Penetration: No leakage at 15 psf (720 Pa) per ASTM E 331.
3. Low Temperature Adhesion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm) at 25 deg F (minus 4 deg C) as Class A without primer use.
4. Adhesion After Water Immersion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm), after AAMA 800, Sections 2.4.1.3.1/2.4.1.4.3, Test B.

2.5 FLUID-APPLIED FLASHING

A. Fluid-Applied Flashing: Trowel or brush applied, non-water soluble, single component, silyl terminated polyether technology (STPE), vapor permeable, flashing material.

1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: E. I. du Pont de Nemours and Company; Tyvek® Fluid Applied Flashing & Joint Compound+.
2. VOC Content: ASTM C 1250, less than 2 percent by weight and between 25 to 30 g/L.
3. Water Vapor Transmission: ASTM E 96, Method B, greater than 20 perms (1100 ng/Pa x s x sq. m) at 25 mils (0.635 mm) thick.
4. Minimum Tensile Strength: ASTM D 412, 165 lb/sq. ft. (1140 kPa)
5. Minimum Elongation at Break: ASTM D 412; 360 percent.

2.6 WEATHER BARRIER ACCESSORIES

A. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by weather barrier manufacturer for sealing joints and penetrations in commercial building wrap.

1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company; Tyvek® Tape.

B. Closed-Cell Polyurethane Foam Insulation: Low pressure, low expansion, single component polyurethane foam, with maximum flame-spread and smoke-developed indexes of 15 and 25, respectively, per ASTM E 84.

1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company; DuPont™ Window & Door Foam.
2. Pressure Build-Up: 0.0247 psi (0.170 kPa) maximum, AAMA 812.
3. Deflection: 0.0050-inch (0.127 mm) maximum, AAMA 812.

C. Fasteners with Self-Gasketing Washers: Commercial building wrap manufacturer's recommended pneumatically or hand-applied fasteners with 1-inch- or 2-inch- diameter, high-density polyethylene cap washers with UV inhibitors, as required by location.

1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company; Tyvek® Wrap Caps.

D. Primer for Flashings: Synthetic rubber-based product; spray applied. Strengthen adhesive bond at low temperature applications between weather products such as self-adhered flashing products, commercial building wraps, and common building sheathing materials.

1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company, DuPont™ Adhesive Primer.
2. Peel Adhesion Test: Passes in accordance with ASTM D 3330, Test Method F, for the following.

a. Peel Angles: 0, 25, 72, and 180 degrees.
b. Substrates: Concrete masonry units (CMU), exterior gypsum sheathing, oriented strand board (OSB), aluminum, and vinyl.

3. Chemical Compatibility: Pass; AAMA 713.
4. Flame Spread Index: 5; ASTM E 84.
5. Smoke Development Index: 0; ASTM E 84.

2.7 DRAINAGE MATERIAL

A. Drainage Material: Product shall maintain a continuous open space between water-resistive barrier and exterior cladding to create a drainage plane and shall be used under siding, and adhered masonry veneer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advanced Building Products Inc.
b. DuPont de Nemours, Inc.
c. Insulfoam; Carlisle Construction Materials Company.
d. Keene Building Products.
e. Masonry Technology Inc. (MTI); 10mm Sure Cavity Rainscreen
f. Mortar Net Solutions.
g. Stuc-O-Flex International, Inc.

2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

3. Thickness: 10mm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements.

B. Verify that substrate and surface conditions are in accordance with commercial weather barrier manufacturer recommendations prior to installation.

1. Verify that rough sill framing for doors and windows is sloped downwards towards the exterior and is level across width of the opening.

C. Verify that surfaces to receive weather barrier flashing are clean, dry, and free of frost.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.

1. Maintain continuity of air and water barrier assemblies.
2. Start weather barrier installation at a building corner, leaving 12 inches of weather barrier extended beyond corner to overlap.
3. Install weather barrier horizontally starting at lower portion of wall surface.
4. Provide minimum 6 inches overlap at horizontal- and vertical-wrap seams in a shingle manner to maintain continuous downward drainage plane and air and water barrier.

B. Seams: Seal seams with building wrap tape per manufacturer's recommended installation instructions.

1. Shiplap horizontal seams in weather barrier to facilitate proper drainage.

C. Fasteners: Use weather barrier manufacturer’s recommended capped fasteners to secure weather barrier and install fasteners according weather barrier manufacturer’s installation guidelines.

1. Do not use temporary fasteners to permanently attach weather barrier.
2. Do not place fasteners with gasketing washers where weather barrier flashing will be installed.
3. Install fasteners with gasketing washers through flashing where recommended by manufacturer.

D. Openings: Completely cover openings with weather barrier, then cut weather barrier membrane to openings according to weather barrier manufacturer's installation guidelines.

1. Provide head and jamb flaps and seam overlaps to maintain continuous drainage.
2. Repair damage to weather barrier using method recommended by weather barrier manufacturer.
3. Install flashing according to weather barrier manufacturer's installation guidelines.

E. Cover sheathing with water-resistive barrier as follows:

1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.

F. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

G. Rough Openings: Shiplap flashing with weather barrier in a shingle manner to maintain a continuous downward drainage plane and air and water barrier in accordance with manufacturer’s written instructions.

1. Apply 6-inch- or 9-inch- wide conformable weather barrier flashing at door and window sills, as required by wall widths.
2. Ensure that sill flashing does not slope to the interior.
3. Install backer rod in joint between frame of opening product and flashed rough opening on the interior.
4. Apply sealant or closed-cell polyurethane foam insulation around entire opening/fenestration product to create air seal around interior perimeter of window openings in accordance with weather barrier manufacturer's instructions.
5. Around door and window openings, apply butyl-based flashing to flaps of weather barrier.
6. Use strip flashing with wrap cap screws to secure head flap of the windows.

H. Penetrations: Apply weather barrier manufacturer's recommended weather barrier flashing patches behind fastening plates, such as brick-tie base plates, metal-flashing clips, and metal channels.

1. Seal weather barrier around each penetration with weather barrier manufacturer's recommended self-adhered flashing product or sealant. Integrate products with flanges into the weather barrier.

I. Terminations: Provide minimum 2 inches overlap using strip flashing on adjoining roof and base of wall systems to maintain continuous downward drainage plane.

1. Secure weather barrier with fasteners and weather-barrier flashing.

3.3 FLUID-APPLIED FLASHING INSTALLATION

A. General: Before installing fluid-applied flashing, do the following:

1. Ensure drainage path is not blocked or disrupted. Do not install on walls that do not feature a continuous path for moisture drainage. Blocked or disrupted paths for drainage can result in excess moisture buildup in wall cavity. Do not install below grade.
2. Remove surface dust, dirt, and loose mortar.
3. Verify that surface is free of grease and other contaminants and that surface is smooth.
4. Fill joints in concrete masonry units, and voids in cast-in-place concrete with trowel-applied fluid-applied flashing to ensure surface is flush and smooth.
5. Allow masonry mortar and cast-in-place concrete a minimum of 24 hours to cure before installing fluid-applied flashing.

B. Fluid-Applied Flashing Installation: Using a trowel or brush, apply fluid-applied flashing around perimeter of window and door openings to a minimum thickness of 25 mils.

1. Extend flashing a minimum of 2 inches onto exterior face of adjacent surface.
2. Inspect for gaps and pinholes in fluid-applied flashing and apply additional coats until no gaps and pinholes appear.
3. Joint Applications: Using a trowel or a brush, fill cracks and voids up to 1/4 inch in width.

    a. For joints and cracks between 1/4 and 1/2 inch wide, cover first with mesh tape.
    b. For joints and cracks between 1/2 and 1 inch wide, cover first with butyl-based strip flashing.
    c. Apply a bead, then trowel smooth.

d. Seam coverage should be a minimum of 2 inches wide and 15 to 20 mils thick.
e. Inspect for gaps and pinholes in fluid-applied flashing and apply additional coats until no gaps and pinholes appear.

3.4 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over water-resistive barrier at bottom and sides of openings.
4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.5 DRAINAGE MATERIAL INSTALLATION

A. Install drainage material over building wrap and flashing to comply with manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to train installers and observe subject test-wall areas and installations.

B. Testing Agency: Engage a qualified third-party testing agency to perform tests and inspections.

C. Test Area: Perform tests on one bay at least 30 feet, by one story and mockups.

D. Field Quality Control Testing: Perform the following test on mockups.

1. Air Infiltration Whole Building: ASTM E 779 at not more than 0.25 cfm/sq. ft. at 1.57 lb/sq. ft (75 Pa).
2. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" article, but not less than 2.86 lbf/sq. ft. No water penetration shall occur as defined in ASTM E 1105.

a. Perform a minimum of three tests in areas as directed by Architect.
b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 30, and 70 percent completion.

E. Prepare test and inspection reports.

3.7 CLEANING

A. Immediately remove release paper and scrap from work area daily and dispose of material in accordance with requirements of General Contractor.

3.8 PROTECTION

A. Protect installed weather barrier from the following:

1. Damage from cladding, structure, or a component of the structure (e.g., window, door, or wall system).
2. Contamination from building site chemicals, premature deterioration of building materials, or nonstandard use or application of products.
3. Foreign objects or agents, including the use of materials incompatible with weather barrier products.
4. UV exposure in excess of products' stated limits.

END OF SECTION 072500

SECTION 073113 ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Asphalt shingles.
2. Ridge vents.
3. Underlayment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each exposed product and for each color and blend specified.

1.3 INFORMATIONAL SUBMITTALS

A. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Fire-Resistance Characteristics: Where indicated, provide asphalt shingles and related roofing materials identical to those of assemblies tested for fire resistance per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Exterior Fire-Test Exposure: Class A; ASTM E 108 or UL 790, for application and roof slopes indicated.

B. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials or workmanship within specified warranty period.

1. Material Warranty Period: 50 years from date of Substantial Completion, prorated, with first 20 years non-prorated.
2. Algae-Discoloration Warranty Period: Asphalt shingles will not discolor 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Laminated-Strip Asphalt Shingles: ASTM D 3462, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.

1. Subject to compliance with requirements, provide Timberline® shingles as manufactured by GAF Roofing Products or approved equal with granules treated to resist algae discoloration. Color shall be selected by the Architect.

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering Sheet Underlayment, Granular Surfaced: ASTM D 1970, minimum of 55-mil thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; mineral-granule surfaced; with release paper backing; cold applied.

1. Subject to compliance with requirements, provide Weather Watch Leak Barrier Water & Ice Shield as manufactured by GAF Roofing Products or approved equal.

2.3 RIDGE VENTS

A. Ridge Vent: Lomanco Lo-OmniRoll Model LOR-30, UV-stabilized plastic ridge vent for use under ridge shingles.

2.4 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Roofing Nails: ASTM F 1667; aluminum or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch diameter, barbed shank, sharp-pointed, with a minimum 3/8-inch diameter flat head and of sufficient length to penetrate at least 1/8 inch through the roof sheathing.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

C. Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch minimum diameter.

2.5 METAL FLASHING AND TRIM

A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Sheet Metal: Prefinished aluminum.

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.

C. Kickout flashing shall be .040-inch-thick powder coated aluminum as manufactured by PBZ LLC or approved equal, pre-formed and welded to 6” x 6” x 10” size. Material shall not be field-formed. Color to be selected by the Architect.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated below, lapped in direction to shed water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.

1. Install one standard 36-inch width of self-adhering sheet underlayment at all valleys, ridges and rakes.
2. Install self-adhering sheet underlayment at all eaves from the outside edge of the overhang up the roof to a point 24-inches beyond the inside face of the outside wall.
3. Install self-adhering sheet underlayment over the entire surface of roof decking with a slope of less than 4/12 prior to the installation of roof shingles.

3.2 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal & Flashing."

1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Install kickout flashings where sloped roof fascias meet vertical walls. Install in accordance with manufacturer's installation instructions and in proper relationship with adjacent construction.

3.3 ASPHALT SHINGLE INSTALLATION

A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip at least 7 inches wide with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 3/8 inch over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Fasten asphalt shingle strips with roofing nails located according to manufacturer's written instructions.

1. When ambient temperature during installation is below 50 deg F, seal asphalt shingles with asphalt roofing cement spots.

E. Closed-Cut Valleys: Extend asphalt-shingle strips from one side of valley 12 inches beyond center of valley. Use one-piece shingle strips without joints in valley. Fasten with extra nail in upper end of shingle. Install asphalt-shingle courses from other side of valley and cut back to a straight line 2 inches short of valley centerline. Trim upper concealed corners of cut-back shingle strips.

1. Do not nail asphalt shingles within 6 inches of valley center.
2. Set trimmed, concealed-corner asphalt shingles in a 3-inch wide bed of asphalt roofing cement.

F. Install ridge vents per manufacturer’s installation instructions, continuous along the ridge from rake to hip or valley.

G. Ridge Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.

END OF SECTION 073113

SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standing-seam metal roof panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review structural loading limitations of purlins and rafters during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft.

D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.

B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.

1. Basis-of-Design Product: Subject to compliance with requirements, provide PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company; Snap-Clad or a comparable product by one of the following:

a. ATAS International, Inc.
b. Berridge Manufacturing Company.
c. CENTRIA, a Nucor Brand.
d. Drexel Metals.
e. McElroy Metal, Inc.
f. Morin - A Kingspan Group Company.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.040 inch.
b. Surface: Smooth, flat finish.
c. Exterior Finish: Two-coat fluoropolymer.
d. Color: As selected by Architect from manufacturer's full range.

3. Clips: One-piece fixed or Two-piece floating, to accommodate thermal movement.

a. Material: 0.028-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

4. Panel Coverage: 16 inches.
5. Panel Height: 1.5 inches.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. ATAS International, Inc.
    b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
    c. GCP Applied Technologies Inc.
    d. Henry Company.
    e. Owens Corning.
    f. Polyglass U.S.A., Inc.
    g. Protecto Wrap Company.
    h. SDP Advanced Polymer Productsc Inc.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match roof fascia and rake trim.

E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

F. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch-nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch-thick, rigid insulation.

G. Panel Fasteners: Self-tapping screws designed to withstand design loads.

H. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Clipless Metal Panel Installation: Fasten metal panels to supports with screw fasteners at each lapped joint at location and spacing recommended by manufacturer.

G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

I. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

J. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

K. Roof Curbs: Install flashing around bases where they meet metal roof panels.

L. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.16

SECTION 074646 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fiber-cement siding, trim, and soffits.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, grounds, nailers, and blocking.
2. Section 072500 "Weather Barriers" for weather-resistive barriers.

1.3 COORDINATION

A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For fiber-cement siding and soffit including related accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of fiber-cement siding and soffit.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.

C. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with labels intact until time of use.

B. Store materials on elevated platforms, under cover, and in a dry location.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including cracking and deforming.
b. Deterioration of materials beyond normal weathering.

2. Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING

A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. James Hardie Building Products, Inc.

1) All Hardie Board Products on this project shall be rated for use in Hardie Board Zone HZ5®.

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Nominal Thickness: Not less than 5/16 inch.

A. Horizontal Lap Siding Pattern: Boards in widths per Architectural Drawings of 12” thru 6.25”, with exposures of 10.75” thru 5”, and other sizes as noted and required.

1. Texture: Smooth.
2. Thickness: 0.312 inch.

B. Vertical Board and Batten Pattern: 48-inch-wide sheets with texture and grooves per Architectural Drawings of 8-inches thru 12-inches o.c.

C. Trim Boards: Hardi Trim Boards shall be as detailed on the Architectural Drawings and selected from 4/4NTS and 5/4NTS, in 3/4" and 1" thicknesses and widths of 11.25", 9.25", 7.25", 5.5" or 3.5", or Artisan Trim in 1.5" thickness x 5.5" or 3.25" widths, as detailed.

1. Texture: Smooth.

D. Factory Priming: Manufacturer's standard acrylic primer.

2.3 FIBER-CEMENT SOFFIT

A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. James Hardie Building Products, Inc.

B. Nominal Thickness: Not less than 5/16 inch.

C. Pattern: 12-inch-,16-inch-, or 24-inch- wide sheets with smooth texture.

D. Ventilation: provide ventilated and non-ventilated panels meeting Code required free air opening space.

E. Factory Priming: Manufacturer's standard acrylic primer.

2.4 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.

B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated:

1. Corner posts.
2. Door and window casings.
3. Fasciae.

C. Flashing: Provide aluminum flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

1. Finish for Aluminum Flashing: High-performance organic finish.

D. Fasteners:

1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch into substrate.

2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
3. For fastening fiber cement, use hot-dip galvanized or stainless-steel fasteners.

E. Insect Screening for Soffit Vents: Aluminum, 18-by-16 mesh.

F. Spacer: 1/8-inch thick by 3-inch wide polyethylene foam product, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and soffit and related accessories.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Do not install damaged components.
2. Install fasteners no more than 24 inches o.c.

B. Install siding and trim materials with joints and spacings as indicated in manufacturer’s instructions to allow for thermal and moisture movement requirements, and to provide properly designed sealant joints.

C. Apply polyethylene foam insulation spacer vertically on the wall every 16 inches o.c. to align with studs and at all changes in wall directions to create a space between the insulation board and fiber cement.

D. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074646

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed steep-slope roof sheet metal fabrications.
4. Formed wall sheet metal fabrications.
5. Balcony T-Bar Concrete Form Edge.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 073113 "Asphalt Shingles" for materials and installation of sheet metal flashing and trim integral with roofing.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.

4. Epoxy seam sealer.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Evaluation Reports: For roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.

E. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing", SMACNA’s “Residential Sheet Metal Guidelines”, and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Color: As selected by Architect from manufacturer's full range.
3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Finish: ASTM A480/A480M, No. 2B (bright, cold rolled).

a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

D. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carlisle WIP Products; a brand of Carlisle Construction Materials.
    b. GCP Applied Technologies Inc.
    c. Henry Company.
    d. Owens Corning.
    e. Protecto Wrap Company.
    f. SDP Advanced Polymer Products Inc.

2. Source Limitations: Obtain underlayment from single source from single manufacturer.
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

B. Slip Sheet: Rosin-sized building paper, 3 lb./100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

    a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

H. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

I. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Fry Reglet Corporation.
    b. Heckmann Building Products, Inc.
    c. Hohmann & Barnard, Inc.
    d. Metal-Era, Inc.
    e. OMG Roofing Products; a Division of OMG, Inc., a subsidiary of Steel Partners Holdings L.P.

2. Source Limitations: Obtain reglets from single source from single manufacturer.
3. Material: Stainless steel, 0.0188 inch thick.
4. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
5. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
6. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
7. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
8. Accessories:

    a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
    b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

9. Finish: With manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch-long sections.
3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
5. Gutter Profile: As indicated on Drawings, in accordance with cited sheet metal standard.
6. Expansion Joints: Lap type.
7. Accessories: Wire-ball downspout strainer, Valley baffles.
8. Gutters with Girth up to 15 Inches: Fabricate from the following materials:

    a. Aluminum: 0.032 inch thick.
    b. Galvanized Steel: 0.022 inch thick.

9. Gutters with Girth 16 to 20 Inches: Fabricate from the following materials:

    a. Aluminum: 0.040 inch thick.
    b. Galvanized Steel: 0.028 inch thick.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Fabricated Hanger Style: In accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Manufactured Hanger Style: In accordance with SMACNA's "Architectural Sheet Metal Manual."
3. Fabricate from the following materials:

    a. Aluminum: 0.024 inch thick.
    b. Galvanized Steel: 0.022 inch thick.

C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Galvanized Steel: 0.028 inch thick.

D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim,. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Galvanized Steel: 0.028 inch thick.

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Galvanized Steel: 0.022 inch thick.

B. Valley Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

C. Drip Edges: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Galvanized Steel: 0.022 inch thick.

D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Galvanized Steel: 0.022 inch thick.

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Galvanized Steel: 0.022 inch thick.

F. Flashing Receivers: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Galvanized Steel: 0.022 inch thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

2.8 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long sections at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Stainless Steel: 0.0156 inch thick.
3. Galvanized Steel: 0.022 inch thick.

C. Wall Expansion-Joint Cover: Fabricate from the following materials:

1. Aluminum: 0.040 inch thick.
2. Stainless Steel: 0.0188 inch thick.
3. Galvanized Steel: 0.028 inch thick.

2.9 BALCONY T-BAR CONCRETE FORM EDGE

A. Balcony T-Bar concrete form edges shall be manufactured by Aluminum Wholesalers, Houston, Texas Phone (713) 955-6375 Model 7107D for 3-inch slab, with 5-inch face with drip edge and 3-inch bearing leg, in mill finished aluminum, 0.080 inches thick, or Architect approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lap joints not less than 2 inches.

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

1. Lap horizontal joints not less than 4 inches.
2. Lap end joints not less than 12 inches.

C. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

D. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than 4 inches.

3.3 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

    a. Embed hooked flanges of joint members not less than 1 inch into sealant.
    b. Form joints to completely conceal sealant.
    c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
    d. Adjust setting proportionately for installation at higher ambient temperatures.

        1) Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:

1. Join sections with riveted joints or joints sealed with sealant.
2. Provide for thermal expansion.
3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Fasten gutter spacers to front and back of gutter.
7. Anchor and loosely lock back edge of gutter to continuous cleat.
8. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
9. Anchor gutter with gutter brackets or straps spaced not more than 24 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
10. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.

C. Downspouts:

1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Provide elbows at base of downspout to direct water away from building.
5. Connect downspouts to underground drainage system.

D. Parapet Scuppers:

1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
2. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
3. Loosely lock front edge of scupper with conductor head.

4. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

E. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below scupper or gutter discharge.

F. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches in direction of water flow.

3.5 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure in waterproof manner by means of snap-in installation and sealant interlocking folded seam or blind rivets and sealant unless otherwise indicated.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.7 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

3.9 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 078413 PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetration firestopping systems for the following applications:

a. Penetrations in fire-resistance-rated walls.
b. Penetrations in horizontal assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

2. All firestopping systems from all related applicable sections shall be manufactured by the same manufacturer.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."
3) FM Approval in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Products shall be manufactured by one of the following: 3M Fire Protection Products, Hilti, Inc. or Specified Technologies, Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

D. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m) on each side of wall.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels on each side of wall. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-

adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

SECTION 078443 JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.

1. Products shall be as manufactured by one of the following: 3M Fire Protection Products, Hilti, Inc. or Specified Technologies, Inc., and of same manufacturer as materials in Section 078413 Penetration Fire Stopping.
2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

D. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

C. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

D. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge on each side of assembly in ceiling space or attic areas so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078443

SECTION 079200 JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Butyl joint sealants.
5. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples: For each kind and color of joint sealant required.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Preconstruction laboratory test reports.

C. Preconstruction field-adhesion-test reports.

D. Field-adhesion-test reports.

E. Sample warranties.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with stone, masonry, aluminum, prefinished sheet metal, concrete, Hardie Board, and vinyl substrates.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range

2.2 URETHANE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.

B. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Uses T and NT.

1. Tremco Dymeric 240FC, MasterSeal NP II, Pecora DynaTrol II

C. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic-use, self-leveling, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.

1. Tremco Vulkem 445SSL, (slopes to 6%); Pecora DynaTrol II-SG, (5% to 15% slope material available as needed).

2.3 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Dow 786, GE SCS1700 Sanitary, Pecora 898NST, or Tremco Tremsil 200.

C. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Pecora AC-20 + Silicone, MasterSeal NP520, Tremco Tremflex 834

2.4 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

1. Tremco Butyl Sealant, Pecora BC 158, or Architect approved equal.

2.5 JOINT-SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Alcot Plastics, Backer Rod Manufacturing, Inc., Williams Products, Inc. or Architect approved equal.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove laitance and form-release agents from concrete.

2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with ASTM C1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other

requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces JS-#1.

1. Joint Locations:

   a. Isolation and contraction joints in cast-in-place concrete slabs.
   b. Joints between different materials penetrating the concrete.
   c. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, M, P, 50, T. See 2.2C above.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces JS-#2.

1. Joint Locations including but not limited to the following:

   a. Construction joints in cast-in-place concrete.
   b. Joints between fiber-cement siding.
   c. Joints in adhered stone masonry veneer.
   d. Joints where dissimilar materials meet.
   e. Perimeter joints between materials and frames of doors, windows, and louvers.
   f. Control and expansion joints in ceilings and other overhead surfaces.
   g. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, M, NS, 50, NT. See 2.2B above.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of color.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement JS-#3.

1. Joint Locations:

   a. Control joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints between interior wall surfaces and frames of interior doors, windows, outlets, vents and diffusers.
   c. Joints where dissimilar materials meet.
   d. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex. See item 2.3C above.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces JS-#4.

1. Joint Locations:

   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. Similar Kitchen countertop areas, and toilet accessory fixtures that might be in the damp/wet zone.

d. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT. See Item 2.3B above.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Concealed mastics JS-#5.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based ASTM C1311. Tremco Butyl Sealant, Pecora BC 158 or Architect approved equal. See 2.4A above.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 082000 PEDESTRIAN DOORS

PART_1 - GENERAL

1.1 SUMMARY

A. Provide all Pedestrian Doors, complete in place, as shown on the Drawings and as specified herein.

1.2 SUBMITTALS

A. The Contractor shall prepare, and submit to the Architect for approval, shop drawings for all work included in this Section and shall not proceed with fabrication and delivery prior to receiving such approval. Show anchors, hardware operators and other components not included in manufacturer's standard data. Include glazing details as well as manufacturer's product data.

1.3 PROTECTION

A. Doors shall be handled with care to prevent damage. The Contractor shall examine all doors prior to installation and repair or replace damaged doors as required.

PART 2 - PRODUCTS

2.1 DOORS

A. Apartment Building entrance doors shall be aluminum and glass storefront doors as specified in Division 08 Section "Aluminum Entrances & Storefronts".

B. Front entrance doors to each apartment unit, and fire sprinkler riser room doors shall be of sizes indicated on the drawings. Door units shall be 1-3/4" thick pre-hung Masonite HD, Steel Edge 2 Panel Square Top, Smooth Steel Doors or approved equal, with two spring and one standard painted hinges, 3-1/2” x 3-1/2” x 5/8” R corners, with hinge stop, view glass, (two, one high and one low for handicap room doors and none for sprinkler room door or Corridor IT and Mech Rooms), and no threshold or door bottom, except for sprinkler room door with 4” min alum threshold set in sealant bed and door bottom w/ drip. Door frames shall be C-series standard fire rated galv. steel frames as manufactured by Timely Industries or approved equal. Door units shall carry a minimum 20 minute fire-resistive rating as tested under NFPA 252 or UL 10C. Doors shall carry manufacturers standard 5 year limited Warranty.

C. Swinging patio doors at the apartment units shall be of sizes indicated on the drawings. Door units shall be 1-3/4” thick pre-hung Masonite HD Steel-Edge Flush Full Lite Steel Doors, or approved equal, with polyurethane core, Low-E tempered insulating glass and thermal break interlocking steel edges, hinge reinforcement, reinforced lockset preparation, painted spring hinges and triple contact extruded vinyl bottom sweep. Door frames shall be 4Ever Frames by Worldwide Door Components, Inc. composite wood frames, or approved equal, with perimeter weatherstripping type TPE magnetic and Endura auto-adjusting

threshold set in full bed of caulking in a continuous sill pan with turned up back and end dams as manufactured by Sure-Sill, also set in sealant per installation instructions. Endura ADA Sill solution set in caulking in a continuous sill pan with turned up back and end dams, as manufactured by Sure-Sill.

D. Raised panel doors within the apartment units shall be of sizes indicated on the drawings. Door units shall be 1-3/8" thick pre-hung Masonite Molded Panel Series 2 Panel Square Top Doors or approved equal, with standard honeycomb hollow core with primed composite wood faces embossed with 2 panel raised panel design set in two piece W.P. split jamb frames with three 3-1/2" paint grade finish hinges (except for pocket doors and by-pass doors) and colonial casings. Doors shall be machined for hardware specified in Division 08, Section "Door Hardware".

E. All steel doors shall carry the manufacturer's standard 20 year warranty.

F. All steel doors shall be supplied prime painted and shall be painted within 30 days of installation. Failure to paint the doors within 30 days may void the warranty.

PART 3 - EXECUTION

3.1 PROCEDURES

A. All doors and their frames shall be set true, plumb, level and in strict accordance with the manufacturer's directions. Provide a solid shim between the door frame and the stud framing behind the strike plate of all exterior entry doors.

B. Door thresholds shall be covered and protected from construction traffic until final cleaning of finished units.

C. Comply with manufacturer's specifications and recommendations for installation of door units, hardware, operators, and other components of work.

D. Protect metal in contact with masonry, steel, concrete or other dissimilar material from contact by neoprene gaskets or bituminous coating.

E. Adjust opening hardware to provide tight fit at contact joints and at weatherstripping, and to ensure smooth operation and weather tight closure.

F. Door jambs may be finger-jointed and factory primed at the Contractor's option.

END OF SECTION 082000

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of access door and frame and for each finish specified.

C. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Attic Access Doors: Subject to compliance with requirements, provide Karp Associates Model KRP-150FR, or approved equal, 22 by 30 inch, prime coated self-closing, self-latching prime coated steel door with concealed fasteners and keyed lock.

B. Access Doors through Draftstops: Subject to compliance with requirements, provide Babcock Davis BDTK Series, or approved equal, 22 by 30 inch, self-closing, self-latching, prime coated flush steel access doors with flush continuous piano hinge and knurled know-key operated latch bolt, operable from both sides.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Concealed Flanges:

1. J.L. Industries, FDWB Series, or approved equal by Acudor, KARP, Milcore or Nystrom.
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal, where required by Code and uninsulated for other areas; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
3. Locations: Wall and ceiling to attic areas.
4. Fire-Resistance Rating: Not less than that of adjacent construction.
5. Temperature-Rise Rating: 450 deg F (250 deg C) (where required) at the end of 30 minutes.
6. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage, factory primed.
7. Frame Material: Same material, thickness, and finish as door.

8. Latch and Lock: Self-closing, self-latching door hardware, operated by screw driver key.

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

D. Frame Anchors: Same material as door face.

E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

C. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed. Owners security consultant to review locking requirements and may adjust mechanisms to comply with his recommendations.

2.6 FINISHES

A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install doors flush with adjacent surfaces or recessed to receive finish material.

3.2 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sectional-door assemblies.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For manufacturer's warranty and finish warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sectional doors to include in maintenance manuals.

B. Manufacturer's warranty.

C. Finish warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

B. Regulatory Requirements: Comply with provisions in the U.S. Department of Justice's "2010 ADA Standards for Accessible Design" and ICC A117.1 applicable to sectional doors.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Failure of components or operators before reaching required number of operation cycles.
c. Faulty operation of hardware.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.

2. Warranty Period: Two years from date of Substantial Completion.

B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - <u>PRODUCTS</u>

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain sectional doors from single source from single manufacturer.

1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
2. Testing: In accordance with ASTM E330/E330M or DASMA 108 for garage doors and complying with DASMA 108 acceptance criteria.
3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.

a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.

4. Operability under Wind Load: Design sectional doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. wind load, acting inward and outward.

2.3 SECTIONAL-DOOR ASSEMBLY

A. Steel Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Overhead Door Corporation; Model 1400-173 or a comparable product by one of the following:

a. C.H.I. Overhead Doors, Inc.
b. Clopay Building Products.
c. Raynor Garage Doors.

B. Operation Cycles: Door components and operators capable of operating for not less than 25,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.

C. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G90 zinc coating.

1. Door-Section Thickness: 2 inches.
2. Section Faces:

a. Exterior Face: Fabricated from single sheets, not more than 24 inches high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.

1) Surface: Manufacturer's standard, paneled.

3. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.040-inch nominal coated thickness and welded to door section.
4. Intermediate Stiles: Provide intermediate stiles formed from not less than 0.040-inch-thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.
5. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place.

a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
b. Hardware Locations: Provide reinforcement for hardware attachment.

D. Track: Manufacturer's standard, galvanized-steel, standard-lift and low-headroom where required, track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.

1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 zinc coating.
2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings.
3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.

    a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide angle or brackets attached to track and wall.
    b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.

E. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and jambs of door.

F. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.

1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.

    a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
    b. Provide double-end hinges where required for doors more than 16 ft. wide unless otherwise recommended by door manufacturer in writing.

2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.

    a. Roller-Tire Material: Manufacturer's standard.

3. Push/Pull Handles: Equip each door with galvanized-steel lifting handles on each side of door, finished to match door.

G. Counterbalance Mechanism:

1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.

    a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.

b. Provide one additional midpoint bracket for shafts up to 16 ft. long and two additional brackets at one-third points to support shafts more than 16 ft. long unless closer spacing is recommended in writing by door manufacturer.

3. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.
4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

H. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.
3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use.
4. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
5. Operator Type: Chamberlain RJ070, side mounted with battery backup and remote light.
6. Motor: Reversible-type with controller (disconnect switch) for interior, clean, and dry motor exposure. Use adjustable motor-mounting bases for belt-driven operators.

    a. Motor Size: As required to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
    b. Electrical Characteristics:

        1) Phase: Single phase.
        2) Volts: 115 V.

7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

    a. Monitored Entrapment Protection: Photoelectric sensor designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.

9. Control Station: Surface mounted, three-position (open, close, and stop) control.

a. Operation: Push button interior and keypad exterior.
b. Interior-Mounted Unit: Full-guarded, surface-mounted, standard-duty, weatherproof-type, NEMA ICS 6, Type 4 enclosure.
c. Exterior-Mounted Unit: Full-guarded, surface-mounted, standard-duty, weatherproof type, NEMA ICS 6, Type 4 enclosure.
d. Features: Provide the following:

1) Radio-control operation.
2) Photocell operation.
3) Audible and visual signals that comply with regulatory requirements for accessibility.

10. Emergency Manual Operation: Push-up type designed so required force for door operation does not exceed 25 lbf.
11. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

I. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
1. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.

B. Tracks:

1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches apart.
2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing,

diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install automatic garage doors openers in accordance with UL 325.

3.3 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.

D. Touchup Painting Galvanized Material: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 083613

SECTION 084133 ALUMINUM ENTRANCES AND STOREFRONTS

PART 1- GENERAL

1.1 SUMMARY

A. Supply and install all Aluminum Entrances as shown on the drawings and as specified herein.

1.2 GLAZING

A. Refer to Part 2 of this section for glazing all aluminum entrance and window units included herein.

1.3 SUBMITTALS

A. The Contractor shall prepare and submit to the Architect, for approval, of complete shop drawings for all work included in this Section, and shall not proceed with fabrication and delivery prior to receiving such approval.

1.4 SAMPLES

A. Per GENERAL CONDITIONS, submit two 12-inch long samples of each specified material. Include any finishes specified herein showing maximum color variation. Resubmit any color variation samples until Architect's approval. Provide any additional samples required by Contractor. Submit any special finish samples before treating quantities of metal for the work.

1.5 GUARANTEE

A. Per GENERAL CONDITIONS, guarantee all finish metal work; for two (2) years.

1.6 MEASUREMENTS

A. Verify all dimensions by taking field measurements. Proper fit and attachment of all component parts is required.

1.7 RESPONSIBILITY

A. Assume sole responsibility for final construction, erection and weathertightness of the complete framing system, including all component parts and connections.

1.8 COORDINATION

A. Coordinate work and scheduling of the work of this Section with other trades for coordination of size of reveals, locations of anchorage, etc.

1.9 INSPECTION

A. Examine all subsurfaces to receive work and report in writing to General Contractor, with a copy to Architect, any conditions that may be detrimental to work. Failure to observe this injunction constitutes a waiver to any subsequent claims to the contrary and will make this Contractor responsible for any corrections the Architect may require. Commencement of work will be construed as acceptance of all subsurfaces.

1.10 DELIVERY AND STORAGE

A. Deliver and store all materials in dry protected areas. Protect from rusting and other damage. Remove any damaged items from site and replace at no cost to Owner.

1.11 CAULKING AND SEALANTS

A. Per manufacturer's recommendations, included in this Section.

1.12 GENERAL DESIGN AND FABRICATION CRITERIA

A. Members shown on drawings are diagrammatic only; perimeter dimensions of members shown on drawings shall be maintained in final designs of work.

B. Use concealed fastenings throughout.

C. Seal members per American National Standards Institute Standards for sealing. Wide surfaces of members shall be sufficiently thickened and reinforced to prevent warps or buckles after installation.

D. Provide interior and exterior neoprene glazing beads as required having a minimum of 1/2 inch grip surface on glass. All glazing shall be flush type. Any individual light shall be accessible for removal or replacement from the exterior without removing unit frames, disturbing building structure or any finish surface.

E. Provide all flashing, drainage and drip systems as detailed or as required of same material as framing to allow for weepage to the exterior of infiltrated water and condensation from within members.

F. Allow for expansion and contraction due to temperature variation and building movement, taking into account the climactic conditions.

G. Connect to supporting structure so as to properly transfer all vertical and horizontal loads. Design members to carry the live and dead loads tributary to them while limiting deflection to 1/175 of the span or to the flexural limit of the glass and or glazing materials.

1.13 PROTECTION

A. At completion of installation protect all members against damage by other trades. Mark glass by application of decals. Remove protection for final inspection and acceptance.

1.14 GLAZING REFERENCE STANDARDS

A. Comply with all applicable standards of the Flat Glass Marketing Association's "Glazing Manual."

1.15 REFERENCES

A. AAMA Metal Curtain Wall, Window, Storefront and Entrance Guide Specifications Manual.

B. AAMA - Aluminum Curtain Wall Design Guide Manual.

C. AAMA - Curtain Wall Manual #10.

D. ASTM E283 rate of air leakage through exterior Windows, Curtain Walls and Doors.

E. ASTM E-331 - Test methods for water penetration of exterior Windows, Curtain Walls and Doors.

F. AAMA 501 - Test methods for water penetration of exterior windows, curtain walls and doors by uniform static and dynamic air pressure differential.

G. ASTM E330 - Uniform Load Deflection Test.

H. ASTM A36 - Structural Steel.

I. ASTM A386 - Zinc Coating (hot dip) or Zinc Chromate paint on assembled steel products.

J. AAMA 1503.1 - Test method for Condensation Resistance Factor (CRF) and ASTM C236-89 Test Method for Thermal Transmission Coefficient (U Value).

K. ASTM C794 - Test method for adhesion-in-peel of elastomeric joint sealants.

L. SSPC - Steel Structures Painting Council.

M. ASTM E90 & E413 Sound Transmission Class Rating.

1.16 PERFORMANCE REQUIREMENTS

A. Provide the manufacturer's stock storefront system, adapted to the application indicated, that complies with performance requirements specified as demonstrated by testing the manufacturer's corresponding stock systems according to test methods indicated.

B. Air infiltration shall be no more than 0.06 CFM per sq. ft. of fixed area at 6.24 PSF pressure differential per ASTM E283.

C. System shall meet a water test with no uncontrolled leakage at 12 psf pressure differential with a water rate of 5 gallons/hr./sq. ft. when tested in accordance with ASTM E331.

D. Design, engineer, fabricate, and install the storefront system to withstand the code required wind load acting inward and outward, normal to the plane of the wall, when tested in accordance with ASTM E 330, with no material failures or permanent deformation of structural members.

1. Structural test pressure shall be equal to 150 percent of the inward and outward acting design wind pressures.

E. The storefront system shall be capable of withstanding building movements including wind loading and of performing within the following limitations:

1. Deflection of framing members perpendicular to the plane of the wall shall not exceed

L/175 of its clear span.

2. Deflection of members parallel to the plane of the wall, when carrying its full dead load, shall not exceed an amount that will reduce glass bite by less than 75 percent of the design dimension and shall not reduce edge clearance between itself and the panel, glass or other fixed member immediately below to less than an inch.

F. The storefront system shall be capable of withstanding expansion and contraction of components caused by an ambient air temperature range from -10 degrees F to +120 degrees F without buckling, stress on glass, edge seal failure, excess stress on curtain wall structure, anchors and fasteners or reduction in performance.

G. Condensation Resistance Factor (CRF) will be determined in accordance with ASTM 1503.1. Test unit of typical sizes indicated on the plans and glazed with glass as specified. The thermal transmittance coefficient (U Value) will be determined in accordance with ASTM C236 and AAMA 1503.1.

NOTE: Data from calculations, test reports on units of different size or non-representation frame/glass proportions are not acceptable.

PART 2- SPECIFIC REQUIREMENTS

2.1 MATERIALS

A. All exposed aluminum work for entrances shall be fabricated by a single aluminum producer.

B. Exterior storefront framing shall be as indicated, 2450 Series thermally broken storefront framing as manufactured by MANKO or approved equal. Framing members shall be 2" x 4-1/2".

C. Aluminum storefront doors shall be as indicated, 135i Series thermally broken medium stile entrance doors as manufactured by MANKO or approved equal, with 1" tempered insulating glass. Doors shall have 10" high bottom rail to comply with ICC/ANSI A117.1.

D. All glazing installed in exterior Aluminum Storefront Entrance Doors shall be 1" thick consisting of 2 layers of 1/4" glass with 1/2" sealed Argon filled air space between. All glazing shall include a low emissivity coating on the second surface. All insulated glazing lites shall be guaranteed air tight and fog free for a ten year period of time commencing with substantial completion of the building. Provide fully tempered safety glazing at locations required by the International Building Code.

1. Glass Type: PPG Solarban 70XL (2) +Clear.

    a. Visible Light Transmittance: 64 percent minimum.
    b. Winter Nighttime U-Factor: .28 maximum.
    c. Summer Daytime U-Factor: .26 maximum.
    d. Solar Heat Gain Coefficient: .27 maximum.
    e. Provide safety glazing labeling.

F. Weatherstripping for exterior doors, shall be compression weatherstripping against fixed stops; at other edges, provide sliding weatherstripping retained in adjustable strip mortised

into door edge.

G. The Door Bottom Rails shall be weatherstripped with an EPDM blade gasket sweep strip applied with concealed fasteners.

H. Glazing Gaskets shall be extruded vinyl or neoprene synthetic rubber, bulb-type, continuous, standard with manufacturer of aluminum frames, black in color.

I. Glazing Beads and Tape shall be Neoprene and butyl, respectively.

J. Aluminum entrance doors shall be provided with the following hardware:

Hinges -	Continuous.
Panic -	Rim panic with Ultra line offset panic pull.
Threshold -	Standard Aluminum handicap profile (set in full bed of caulk)
Closers -	LCN 4041 surface-mounted.
Access Control -	Electronic Strike with wall mounted control. Coordinate with Owners security requirements and provider for prox/card/etc. reader.

K. Extruded Aluminum shall be 6063-T5 alloy and temper (ASTM B221 alloy T5 temper).

L. All Other Materials not specifically described but required for the complete installation of the aluminum entrances and windows shall be new, first quality of their respective kinds and subject to approval of Architect.

2.2 FINISH

A. All exposed aluminum specified in this Section shall be free from alloy defects, die markings, scratches, blisters, "leave-off marks" or other surface blemishes.

B. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer’s written instructions.
2. Color and Gloss: As selected by Architect from manufacturer’s full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All framing shall be set in correct locations as shown in the details and shall be level, square, plumb and in alignment with other work in accordance with the manufacturer's installation instructions and approved shop drawings. All joints between framing and the building structure shall be sealed in order to secure a watertight installation.

B. Install all work specified herein (including hardware for doors) under direct supervision of manufacturer's representatives; use mechanics skilled in this type of work. Erect any required supporting steel work per requirements of applicable Sections of Division 5.

C. Protect all work from corrosion or galvanic action which may be caused by any material

adjacent thereto. Any steel supporting work shall be galvanized and prime coated before installation.

D. Provide shims and anchors as required so work is plumb, level, true, firmly fastened and fully operable at completion.

E. Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

F. Protect adjacent work areas and finish surfaces from damage during product installation.

G. Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and random site visits for inspection of product installation in accordance with manufacturer's instruction.

3.2 CLEANING & PROTECTION

A. Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

B. Protect installed product's finish surfaces from damage during construction.

3.3 CLEAN-UP

A. Per GENERAL CONDITIONS.

END OF SECTION 084133

SECTION 085313 - VINYL WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes vinyl-framed windows.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for vinyl windows.

B. Shop Drawings: For vinyl windows.

1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches in size.

D. Product Schedule: For vinyl windows. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of vinyl window, for tests performed by a qualified testing agency.

B. Sample Warranties: For manufacturer's warranties.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating vinyl windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace vinyl windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain vinyl windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: R.
2. Minimum Performance Grade: 35.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.31.

2.3 VINYL WINDOWS

A. Basis-of-Design Product: Subject to compliance with requirements, provide MI Windows and Doors, LLC; 3500 Model or a comparable product by one of the following:

1. JELD-WEN, Inc.
2. Milgard Manufacturing, LLC.
3. PGT Custom Windows + Doors; PGT Innovations (PGTI).
4. Pella Corporation.
5. Ply-Gem.

B. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Single hung.

C. Frames and Sashes: Impact-resistant, UV-stabilized PVC complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Exterior Finish: As selected by Architect from manufacturers full range.
2. Interior Finish: Integral color, white.

D. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.

1. Kind: Fully tempered where indicated on Drawings and as required by safety glazing locations.

E. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

a. Tint: Clear.
b. Kind: Fully tempered where indicated on Drawings and as required by safety glazing locations.

2. Lites: Two.
3. Filling: Fill space between glass lites with argon.
4. Low-E Coating: Pyrolytic or sputtered on second surface.

F. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

G. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

H. Hung Window Hardware:

1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only. Provide custodial locks.
3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis to facilitate cleaning exterior surfaces from the interior.
4. Limit Devices: Limit window opening to 4 inches when sash is opened. Device may be disengaged, allowing window to open fully for cleaning or egress and automatically re-engages when the sash is fully closed again.

I. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

J. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Half, outside for single-hung sashes.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.
2. Finish for Interior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range.
3. Finish for Exterior Screens: Matching color and finish of cladding.

C. Glass-Fiber Mesh Fabric: Mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656/D3656M.

1. Mesh Color: Manufacturer's standard.

2.5 FABRICATION

A. Fabricate vinyl windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze vinyl windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, compatible with window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units. Provide manufacturer's standard finish to match window units.

E. Hardware: Mount hardware through double walls of vinyl extrusions or provide corrosion-resistant reinforcement.

F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
2. Air-Infiltration Testing:

    a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
    b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing:

    a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    b. Allowable Water Infiltration: No water penetration.

4. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under "Performance Requirements" Article, but not less than 4.16 lbf/sq. ft., and shall not show evidence of water at the interior side of the assembly. Test area shall include the test assembly and joints between the assembly and the adjacent construction.
5. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
6. Test Reports: Prepared according to AAMA 502.

C. Windows will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.

1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085313

SECTION 087100 DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Keying Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Samples: For each exposed product in each finish specified.

D. Door hardware schedule.

E. Keying schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
2. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

a. Electromagnetic Locks: Five years from date of Substantial Completion.
b. Exit Devices: Two years from date of Substantial Completion.
c. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design", ICC A117.1 and HUD's "Fair Housing Accessibility Guidelines".

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Products shall be as manufactured by PBB, Inc.

2.3 SELF-CLOSING HINGES AND PIVOTS

A. Self-Closing Hinges and Pivots: BHMA A156.17.

1. Products shall be as manufactured by PBB, Inc.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Deadbolts: Minimum 1-inch (25-mm) bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

D. Lock Trim:

1. Description: See Schedule.
2. Levers: Yes.
3. Escutcheons (Roses): Round.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Bored Locks: BHMA A156.2; Grade 2; Series 4000.

1. Products shall be manufactured by PDQ.

2.5 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.36: Grade 2; with strike that suits frame.

B. Push-Button Combination Locks: BHMA A156.36; cylindrical; Grade 1; lock opens by entering a one- to five-digit code by pushing correct buttons in correct sequence; automatically relocks when door is closed; with strike that suits frame.

2.6 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade 2; with faceplate to suit lock and frame.

2.7 ELECTROMAGNETIC LOCKS

A. Electromagnetic Locks: BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full-exterior or full-interior type, as required by application indicated.

1. TBD

2.8 ELECTROMECHANICAL LOCKS

A. Electromechanical Locks: BHMA A156.25; Grade 2; motor or solenoid driven; with strike that suits frame.

1. TBD
2. Type: Bored.

2.9 SELF-CONTAINED ELECTRONIC LOCKS

A. Self-Contained Electronic Locks: BHMA A156.25, bored; with internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case, and strike that suits frame. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock.

1. TBD

2.10 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks and Alarms: BHMA A156.29, Grade 1.

1. Products shall be as manufactured by Detex.

2.11 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Detex and Cal-Royal

2.12 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

1. PDQ

B. Standard Lock Cylinders: BHMA A156.5; Grade 2 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable.

C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.13 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. Master Key System: Change keys and a master key operate cylinders.

a. Provide three cylinder change keys and five master keys.

2. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.

    a. Provide three cylinder change keys and five each of master and grand master keys.

B. Keys: Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

    a. Notation: Information to be furnished by Owner.

2.14 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 120 percent of the number of locks.

1. Product shall be as manufactured by: American Key Boxes and Cabinets, GE Security, Inc., HPC, Inc., Lund Equipment Co., Inc., TelKee; Oasis International or Architect Approved equal.
2. Multiple-Drawer Cabinet: Grade 2 cabinet with drawers equipped with key-holding panels and key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.
3. Wall-Mounted Cabinet: Grade 2 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
4. Portable Cabinet: Grade 2 tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

2.15 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. American Eagle

2.16 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

1. Cal-Royal, PDQ, Ives

2.17 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. National Guard, Pemko, Hager Companies

B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.

2.18 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Hager Companies; Endco; Sealeze; National Guard Products; Pemko Manufacturing Co.; Reese Enterprises, Inc.; Sealeze; Zero International

2.19 SLIDING DOOR HARDWARE

A. Sliding Door Hardware: BHMA A156.14; consisting of complete sets including rails, hangers, supports, bumpers, floor guides, and accessories indicated.

1. Complete by sliding door manufacturer. Baer Supply; Johnson Hardware Co.; McMaster-Carr; Richelieu Hardware: Stanley;

2.20 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Ives; Call-Royal; Don Jo; Pamex;

B. Auxiliary Hardware: BHMA A156.16.

1. Ives; Trimco; Builders Hardware; Cal-Royal; Don Jo; Pamex

2.21 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated on Drawings and to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30

inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

E. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, in equipment room. Verify location with Architect.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.2 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.3 PRODUCTS

A. Hardware taken from catalogs of the following manufacturers unless otherwise noted:

Locks:	PDQ
Hinges	PBB
Hinge Pin Stop	Pamex
Door Viewers:	Cal-Royal
Door Knocker:	Cal-Royal
Stops:	Cal-Royal
Closers:	American Eagle
Kickplates:	PDQ
Thresholds:	Nat’l Guard
Weatherstrips:	Nat’l Guard
Exit Devices:	Detex

B. In general, hardware finish shall be US26D (Satin Chrome) unless specified differently on Hardware Schedule.

C. Supply Cal-Royal HDFS3 door stops in the Apartment Dwelling Units.

D. Supply out swinging exterior doors with non-removable pins. Also with raised lip on inside of thresholds, in compliance with ADA requirements.

3.4 APARTMENT HARDWARE SCHEDULE

HARDWARE SET #1

Unit Entry Doors (20 min. Rated):

1	each	Entrance Lock	SD116 MEM US26D
1	each	Single Cylinder Deadbolt	KV116 US26D
1	each	Door Viewer	ULDV180 N
1	each	Threshold	425E (ground floors) (upper floors TBD after corridor walking surface selection)
1	each	Door Shoe	35EV
1	each	Hinge Pin Stop	DD02-41

Grand Master Key System: Change keys, a master key, a grand master key, and a grand master key operate cylinders.

a. Provide three cylinder change keys and five each of master, grand master, and great-grand master keys.

BALANCE OF HARDWARE BY DOOR SUPPLIER (NOTE TWO HINGES SHALL BE SPRING HINGES AND SELF CLOSING)

WEATHERSTRIPPING or SMOKE GASKET BY DOOR SUPPLIER as req. by location.

HARDWARE SET #2

Accessible Unit Entry Doors (20 min. Rated):

1	each	Entrance Lock	SD116 MEM US26D
1	each	Single Cylinder Deadbolt	KV116 US26D
2	each	Door Viewers	ULDV180 (one mounted at accessible height)
1	each	Threshold	896
1	each	Brush	95WH
1	each	Hinge Pin Stop	DD02-41

BALANCE OF HARDWARE BY DOOR SUPPLIER (NOTE TWO HINGES SHALL BE SPRING HINGES AND SELF CLOSING)

THUMB TURN DEADBOLT SHALL BE AN ADA ACCESSIBLE DEVICE ON ALL ACCESSIBLE UNITS

WEATHERSTRIPPING OR SMOKE GASKET BY DOOR SUPPLIER

HARDWARE SET #3

Bedroom and Bathroom Doors

1	each	Privacy Lock	SD176 MEM US26D
1	each	Hinge Pin Stop	DD02-41

BALANCE OF HARDWARE BY DOOR SUPPLIER

HARDWARE SET #4

Single Swing Closet Doors

1	each	Passage Latch	SD126 MEM US26D
1	each	Hinge Pin Stop	DD02-41

BALANCE OF HARDWARE BY DOOR SUPPLIER

HARDWARE SET #5

Not Used

HARDWARE SET #6

Patio and Balcony Swing Doors (locks to be keyed to individual apartment entrance deadbolt)

1	each	Entrance Lock	SD116 MEM US26D
1	each	Single Cylinder Deadbolt	KV116 US26D (at Ground Floor Only)
1	each	Threshold	Endura 7-9/16” In-Swing Sill
1	each	Hinge Pin Stop	DD02-41

BALANCE OF HARDWARE BY DOOR SUPPLIER

HARDWARE SET #7

AHU/HWH Doors

1	each	Single Cylinder Deadbolt	KV116 US26D

BALANCE OF HARDWARE BY DOOR SUPPLIER

HARDWARE SET #8

Closet/Laundry Pair of Doors

2	each	Dummy Trim	SD211 MEM
2	each	Ball Catch	DIB1

BALANCE OF HARDWARE BY DOOR SUPPLIER

HARDWARE SET #9

Not Used

3.5 COMMON AREA HARDWARE SCHEDULE

HARDWARE SET #CA1

Water Room & Pool Equipment Doors:

3	each	Hinges	BB81 4-1/2x 4-1/2
1	each	Storeroom Lock	SD115 MEM
1	each	Rain Drip Guard	NGP 16SS
1	each	Weatherstripping	NGP 160V
1	each	Bottom Sweep	NGP 200NSS
1	each	Threshold	NGP 8633

HARDWARE SET #CA2

ADA Garage Door:

3	each	Hinges	BB81 4-1/2x 4-1/2
1	each	Entrance Lock	SD116 MEM
1	each	Rain Drip Guard	NGP 16SS
1	each	Weatherstripping	NGP 160V
1	each	Bottom Sweep	NGP 200NSS
1	each	Threshold	NGP 8633

3.6 CLUBHOUSE HARDWARE SCHEDULE

HARDWARE SET #CH1

Exterior Entry Doors:

3	each	Hinges	BB81 4-1/2x 4-1/2
1	each	Panic Device	PDQ 6300 Rim Device Entrance Function
1	each	Closer	7101-PA 689
1	each	Weatherstripping	NGP 160V
1	each	Bottom Sweep	NGP 200NSS
1	each	Threshold	NGP 8633

HARDWARE SET #CH2

Office Doors:

3	each	Hinges	BB81 4-1/2x 4-1/2
1	each	Office Function	SD211 MEM
1	each	Wall Stop	PDQ 102

HARDWARE SET #CH3

Package and Fitness Doors:

3	each	Hinges	BB81 4-1/2x 4-1/2
1	each	Storeroom Function	SD115 MEM
1	each	Closer	7101-PA 689

ACCESS CONTROL WITH ELECTRIC STRIKE

HARDWARE SET #CH4

Mech/I.T./Janitor Doors:

3	each	Hinges	BB81 4-1/2x 4-1/2
1	each	Storeroom Lock	SD115 MEM US26D
1	each	Closer	7101-PA 689
1	each	Kickplate	PDQ 980 Series; 10-inch height; 630(US32D)

HARDWARE SET #CH5

Public Bathroom Stall Doors:

3	each	Hinges	BB81 4-1/2x 4-1/2
1	each	Privacy w/ Indicator	YPL02
1	each	Closer	7101-PA 689
1	each	Kickplate	PDQ 980 Series; 10-inch height; 630(US32D)
1	each	Coat Hook	PDQ 902

HARDWARE SET #CH6

Storage Door:

3	each	Hinges	BB81 4-1/2x 4-1/2
1	each	Storeroom Lock	SD115 MEM
1	each	Rain Drip Guard	NGP 16SS
1	each	Weatherstripping	NGP 160V

HARDWARE SET #CH7

Exterior Restroom Door:

3	each	Hinges	BB81 4-1/2x 4-1/2
1	each	Privacy w/ Indicator	YPL02
1	each	Closer	7101-PA 689
1	each	Coat Hook	PDQ 902
1	each	Weatherstripping	NGP 160V
1	each	Bottom Sweep	NGP 200NSS
1	each	Threshold	NGP 8633

END OF SECTION 087100

SECTION 088300 MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:

1. Annealed monolithic glass mirrors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.

C. Samples:

1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
2. Mirror Clips: Full size.
3. Mirror Trim: 12 inches long.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction test reports.

B. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Glazing Publications: Comply with GANA's "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

B. Safety Glazing Products: For mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

C. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing and substrates on which mirrors are installed.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

B. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; clear.

1. Nominal Thickness: 1/4 inch.

C. Safety Glazing Products: For tempered mirrors, provide products that comply with 16 CFR 1201, Category II.

2.2 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

C. Perimeter Frames: In style, color, finish and size as selected by Owner. May be combined as an assembly with mirrors.

D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.3 MIRROR HARDWARE

A. Top and Bottom Mirror Mounting Clips: #277 mirror clips as manufactured by Knape & Vogt or approved equal.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation.

2.4 FABRICATION

A. Cutouts: Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

B. Mirror Edge Treatment: Flat polished. Seal edges of mirrors with edge sealer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

1. Provide wood blocking between studs as required for solid and secure mirror attachments.
2. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.
3. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

B. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

C. Install wall mounted annealed glass mirrors in the Apartment units with mirror clips. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

D. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

E. Protect mirrors from breakage and contaminating substances resulting from construction operations.

F. Do not permit edges of mirrors to be exposed to standing water.

G. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

H. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

SECTION 092900 GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum board, Type X.
2. Gypsum ceiling board.
3. Mold-resistant gypsum board.
4. Gypsum board, Type C.
5. Glass-mat, water-resistant backing board.
6. Resilient channels.
7. Interior trim.
8. Joint treatment materials.
9. Sound-attenuation blankets.
10. Acoustical sealant.

1.3 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Products as manufactured by one of the following: CertainTeed Corporation, Georgia Pacific Gypsum LLC, National Gypsum Company, USG Corporation, or Architect Approved equal.
2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Products as manufactured by one of the following: CertainTeed Corporation, Georgia Pacific Gypsum LLC, National Gypsum Company, USG Corporation, or Architect Approved equal.
2. Thickness: 1/2 inch (12.7 mm).
3. Long Edges: Tapered.

C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Products as manufactured by one of the following: CertainTeed Corporation, Georgia Pacific Gypsum LLC, National Gypsum Company, USG Corporation, or Architect Approved equal.
2. Core: 5/8-inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

1. Products as manufactured by one of the following: CertainTeed Corporation, Georgia Pacific Gypsum LLC, National Gypsum Company, USG Corporation, or Architect Approved equal.
2. Core: As indicated on Drawings 1/2 inch, regular type 5/8 inch, Type X.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 RESILIENT CHANNELS

A. Resilient Channels: USG, RC-1 or equal.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material:
2. Shapes:
    a. Cornerbead.
    b. Bullnose bead.
    c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    d. L-Bead: L-shaped; exposed long flange receives joint compound.
    e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    f. Expansion (control) joint.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Tile Backing Panels: 10-by-10 glass mesh.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. As recommended by panel manufacturer and tile manufacturer.

2.8 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

D. Acoustical Sealant: Sheetrock Brand Acoustical sealant as manufactured by USG or approved equal.

1. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 INSTALLATION AND FINISHING OF PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C840.

C. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

D. Prefill open joints, rounded or beveled edges, and damaged surface areas.

E. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

F. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

G. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.2 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 096500 VINYL PLANK FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Supply and install all Vinyl Plank Flooring as shown on Drawings and as specified herein.

1.2 SAMPLES

A. Submit two samples of each material specified herein.

1.3 INSPECTION

A. Examine all subsurfaces to receive work and report in writing to the General Contractor, with a copy to the Architect, any conditions detrimental to the successful installation of the vinyl flooring specified. Failure to observe this injunction constitutes a waiver to any subsequent claims to the contrary and holds Vinyl Flooring Contractor responsible for any corrections Architect may require. Commencement of Work will be construed as acceptance of all subsurfaces.

1.4 DELIVERY & STORAGE

A. Deliver materials to job site in manufacturer's original, unopened packaging and adequately protect against damage while stored in dry location at the site.

1.5 PREPARATION

A. Subsurfaces shall be thoroughly dry (verify by moisture meter tests), free of unevenness, foreign material (oil, grease, paint, etc.), broom-clean and vacuumed. Maintain temperature recommended by manufacturer in spaces where Work is being done and where material is stored for periods of time.

1.6 MAINTENANCE MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Vinyl Plank Flooring: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Supply and install all Vinyl Plank Flooring in the Apartment Units as shown on the

Drawings and as specified herein under an allowance of $2.00 per square foot, complete and in place including all labor, materials, accessories, etc. Color to be selected by the Owner.

B. Leveling and Patching Compounds: Latex types as recommended by flooring manufacturer.

PART 3 - EXECUTION

3.1 PROCEDURES

A. Use leveling and patching compounds as recommended by flooring manufacturer for filling small cracks, holes and depressions in subfloors.

B. Installer is required to inspect subfloor surfaces to determine that they are satisfactory. A satisfactory subfloor surface is defined as one that is smooth and free from cracks, holes, ridges, loose debris, drywall compound and other defects impairing the performance or appearance of the vinyl flooring.

C. Install vinyl flooring using method indicated by in strict compliance with manufacturer's printed instructions. Extend vinyl flooring into toe spaces, door reveals, under movable equipment and into closets and similar openings.

D. Scribe, cut and fit vinyl flooring to permanent fixtures, and cabinets, pipes, outlets, and permanent walls and partitions.

E. Maintain temperature in space to receive vinyl flooring materials at not less than 65 F. for 48 hours before installation and 48 hours after installation. Maintain minimum temperature of 55 F. after flooring is installed for duration of project.

3.2 CLEANING AND FINISHING

A. Protect installed flooring with heavy Kraft paper or other covering.

B. After completion of project and just prior to final inspection of work, thoroughly clean floors and accessories.

C. Instruct the Owners representative in the proper maintenance of the installed vinyl flooring.

END OF SECTION 096500

SECTION 09681 CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Supply and install all Carpet Work as shown on the Drawings and as specified herein under the following allowance:

1. Apartment Units: $12.50 per square yard furnished and installed.

1.2 SAMPLES

A. Submit 18" x 27" samples of each carpet required, and 6" lengths of exposed edge stripping.

1.3 DELIVERY AND STORAGE

A. Deliver carpeting materials in protective wrapping, and store inside, protected from weather, moisture and soiling.

1.4 QUALITY ASSURANCE

A. Carpet work shall be installed by a firm with not less than 2 years of carpeting experience, similar to work of this Section.

1.5 WARRANTY

A. Provide special project warranty, signed by Contractor, Installer and Manufacturer (Carpet Mill), agreeing to repair or replace defective materials and workmanship of carpeting work during 1-year warranty period following substantial completion. Attach copies of product warranties.

1.6 INSPECTION

A. Prior to installation of carpet in each area, the Contractor shall carefully examine all surfaces to be covered and report all major defects to the General Contractor for correction prior to starting the installation. After accepting the surfaces, the Contractor shall be fully responsible for the final results, and he shall furnish all underlayment and minor patching required to produce smooth finish floor surfaces.

1.7 MAINTENANCE MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpeting: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Supply all carpet, 1/2”– 6# density rebond pad, and required for a complete installation.

B. Tackless Carpet Stripping: Water resistant plywood strips, 3/8" thick with angular pins protruding from top designed to grip and hold stretched carpet at the backing. Provide stripping with 2 rows of pins.

C. Carpet Edge Guard, Metallic: Extruded aluminum bend down type edge guard; with concealed gripper teeth and minimum 1-1/2" wide punched anchorage flange and minimum 5/8" wide face flange. Provide in hammered texture with anodized aluminum finish of colors selected by the Architect from among standard colors available within the industry (any manufacturer).

D. Seaming Cement: Hot melt seaming adhesive or similar product recommended by carpet manufacturer, for taping seams and buttering cut edges at backing to form secure seams and prevent pile loss at seams.

E. Miscellaneous Materials: As recommended by manufacturers of carpet, cushions and other carpeting products; and selected by Installer to meet project circumstance and requirements.

PART 3 - EXECUTION

3.1 PROCEDURES

A. Examine substrates for moisture content and other conditions under which carpeting is to be installed. Repair minor holes, cracks, depressions or rough areas using material recommended by carpet or adhesive manufacturer. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

B. Clear away debris and scrape up cementitious deposits from surfaces to receive carpeting; vacuum clean immediately before installation. Check concrete surfaces to ensure no "dusting" through installed carpet; apply sealer where required to prevent dusting.

C. Comply with manufacturer's instructions and recommendations for seam locations and direction of carpet; maintain uniformity of direction and lay of pile. At doors, center seams under doors; do not place seams in traffic direction at doorways.

D. Extend carpet under open-bottomed obstructions and under removable flanges and furnishings, and into alcoves and closets of each space.

E. Provide cut-outs where required, and bind cut edges properly where not concealed by protective edge guards or overlapping flanges.

F. Maintain edges and seams straight and square with adjacent surfaces.

G. Install carpet edge guard where edge of carpet is exposed; anchor guards to substrate.

H. Install tackless carpet stripping with adhesive or by nailing, or both where required for adequate strength. Locate properly for concealment of carpet edge between stripping and base of wall. Strip entire perimeter of each carpeted space, and where possible at obstructions and cutouts.

I. Install Cushion as follows:

1. Run seams in pad at 90-degree angle with carpet seam.
2. Place cushion with smoothest face up.
3. Apply 2" fabric type adhesive tape on cushion seams.
4. Install pad over areas to be carpeted with edges butted against stripping. Install in largest sizes practicable for minimum number of seams.
5. Apply slight stretch to pad to remove bubbles and wrinkles.

J. Install carpet as follows:

1. Trim edges, butter cuts with seaming cement, tape or sew, or tape and sew seams to provide sufficient strength for stretching and continued stresses during life of carpet. Apply seaming cement over stitching on backing, if not covered by tape.
2. Seam carpet using heat bonding method.
3. During seaming, exercise care to prevent improper temperature of seaming iron. Correct cupping or peaking of seams while seam is being made.

K. Stretch carpet both directions, the exact amount recommended by carpet manufacturer; trim edges, secure to stripping and conceal behind edge of stripping. Use power stretchers where sufficient space is available to operate stretchers properly.

3.2 SHOP DRAWINGS AND SUBMITTALS

A. Samples: Submit 18" x 27" samples of each carpet required, 1'-0" long samples of each type exposed edge stripping, and 1'-0" square samples of separate cushions. Carpet selection will be made by the Architect.

B. Maintenance Data: Submit manufacturer's printed maintenance recommendations, including methods and frequency recommended for maintaining carpet in optimum condition under anticipated traffic and use conditions.

C. In addition to Maintenance Materials specified in Part 1 of this Section, deliver specified overrun (if any) and usable scraps of carpet to Owner's designated storage space, properly packaged (paper wrapped) and identified. Usable scraps are defined to include roll ends of less than 9'-0" length, and pieces of more than 3 sq. ft. in area and more than 8" wide. Dispose of smaller pieces as "construction waste".

END OF SECTION 096816

SECTION 099100 PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Paint and finish all interior and exterior exposed surfaces as scheduled herein and as indicated on Drawings, excepting work that may be specified elsewhere as being the particular responsibility of another Section. However, all surfaces left unfinished by the requirements of other Sections (Trades) shall be painted or finished as part of the work of this Section.

1.2 SURFACES NOT INCLUDED

A. Unless otherwise indicated, all concealed surfaces such as furred spaces, foundation spaces, pipe spaces, duct shafts, utility tunnels and the like. Any concealed rough hardware, miscellaneous metal in unfinished spaces.

B. Non-ferrous metals unless specifically indicated otherwise. Any moving parts of operating units. Mechanical and electrical parts unless otherwise indicated.

C. Plumbing fixtures, toilet room accessories.

D. Lighting fixtures except as noted on Drawings or specified herein.

E. Any factory finished metal surfaces, paneling, equipment or other materials with complete factory-applied finish, unless specifically directed herein. Any labels or equipment nomenclature, identifications and the like.

F. Finish hardware, unless primed for paint finish.

G. Any acoustical, glass, plastic, tile, flooring unless otherwise specified.

H. Any areas indicated "Unfinished" on Finish Schedule or Drawings.

I. Kitchen cabinets and vanities.

J. Metal or vinyl windows and doors.

1.3 REFERENCE STANDARDS

A. Comply manufacturer’s written instructions and recommendations in “MPI Architectural Painting Specification Manual” applicable to substrates and paint systems indicated, unless otherwise particularly specified herein.

1.4 SUBMITTALS

A. Manufacturer's Data:

1. Complete materials list of all items proposed for the Work specified.
2. Manufacturer's specifications, recommendations and other data required to demonstrate compliance with the specified requirements.

B. Samples: Following Architect's selection of colors and glosses specified herein, submit samples for Architect's review.

1. Provide two samples of each color and each gloss for each material on which the finish is specified to be applied.
2. Unless otherwise directed by Architect, samples shall be approx. 12" (30cm) square.

1.5 HANDLING AND STORAGE

A. Deliver all materials to job site in original, new and unopened containers bearing manufacturer's name and label showing the following information:

1. Manufacturer's stock number and name.
2. Material name or title.
3. Contents by volume of major constituents.
4. Thinning and application instructions.

B. Provide safe and adequate storage to prevent damage to, and deterioration of, paint materials.

C. Use all means necessary to protect the materials before, during and after application and to protect the Work and materials of all other trades.

1.6 PRIME COAT COORDINATION

A. Provide finish coats compatible with prime coats. Review other Sections (Trades) as required, verifying prime coats to be used and ensuring compatibility of the total coating system for the various surfaces.

B. Notify Architect in writing of anticipated problems in using specified coating systems over any primer supplied under other spec. Sections.

1.7 PAINTING PRECONDITIONS

A. Inspection: Prior to painting, carefully inspect installed Work of all other trades and verify that all such Work is complete to the point where this application may properly begin. Verify that painting may be completed in strict accordance with the original design and with the manufacturer's recommendations as approved by Architect. Do not proceed in areas of discrepancy until all such discrepancy has been resolved.

B. Surface Temperatures: Do not apply solvent-thinned paints when surface temperature and surrounding air temperature are below 45 degrees F., unless otherwise permitted by manufacturer's printed instructions as approved by Architect.

C. Weather Conditions: Do not apply paint in snow, rain, fog or mist; or when relative humidity exceeds 85%; or to damp or wet surfaces; unless otherwise permitted by manufacturer's printed instructions as approved by Architect. Application may be continued during inclement weather within temp. limits specified by paint manufacturer during application and drying periods.

1.8 SURFACE PREPARATION

A. General: Prepare and clean all surfaces as per paint manufacturer's recommendations as approved by Architect.

1. Remove all removable items in place and not scheduled to receive paint, or provide surface-applied protection prior to painting. On completion of painting in each space or area, reinstall removed items with workmen skilled in the necessary trades.
2. Clean each surface to be painted prior to applying paint or surface treatment. Remove oil and grease with clean cloths and cleaning solvents of low toxicity and a flash point in excess of 100 degrees F., prior to mechanical cleaning. Schedule cleaning and painting so dust and other contaminants from cleaning process will not fall onto wet newly painted surfaces.

B. Wood Surfaces: Clean all wood surfaces until free of dirt, oil and all other foreign substances.

1. Sand smooth all finished wood surfaces exposed to view. Where required, use varying degrees of sandpaper coarseness to produce uniformly smooth, unmarred wood surfaces.
2. Fill, putty and sand smooth all nail holes and other minor defects in wood trim.
3. Unless specifically approved by Architect, do not paint wood surfaces until moisture content of wood is 12% or less as measured by moisture meter.

B. Metal Surfaces: Thoroughly clean all metal surfaces until completely free of dirt, oil, grease. On galvanized surfaces, use solvent for initial cleaning and then treat surface thoroughly with phosphoric acid etch. Remove all etching solution before proceeding. Allow to dry before painting.

1.9 PAINT APPLICATION

A. General: Slightly vary color of succeeding coats. Do not apply additional coats until previous coats have been inspected and approved. Sand and dust between enamel coats to remove all defects visible to the unaided eye from a distance of five feet. Paint back sides of all removable and hinged panels to match exposed sides.

B. Drying: Allow sufficient drying time between coats. Modify the period as recommended by manufacturer to suit adverse weather conditions. Oil-base and oleo-resinous solvent-type paints shall be considered dry for recoating when paint feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another paint coat does not cause

lifting or adhesion loss of undercoat.

C. Brush Application: Brush-out and work all coats onto surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness and other surface imperfections are not acceptable.

D. Spray Application: Confine to metal framework, woodwork, walls and similar surfaces where hand brush work would be inferior. Wherever spray application is used, apply each coat to provide the equivalent hiding of brush-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of two coats in one pass.

1.10 MATERIALS AND EQUIPMENT

A. General: Provide the best quality grade of the various types of coatings regularly manufactured by paint materials manufacturers approved by the Architect. Materials not displaying manufacturer's identification as the standard best-grade product are not acceptable.

B. Durability: Do not use paint materials which will not withstand normal washing as required to remove pencil marks, ink, ordinary soil and similar material without showing discoloration, loss of gloss, staining or other damage.

C. Colors, Glosses: Architect will select colors for use in the various types of paint specified and will be the sole judge of acceptability of the various glosses obtained from the materials proposed for use by the Contractor.

D. Other Materials: Any other materials not specifically described but required for the complete installation of the Work, shall be new, first quality of their respective kinds, and as selected by Contractor subject to approval of Architect.

1.11 COMPLETION AND CLEANING

A. Upon completion of the Work, carefully clean all glass, hardware, unpainted surfaces, etc. and remove all misplaced paint and spots or spills and leave the Work in condition acceptable to the Architect.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All paint, stain, and varnish shall be products of Devoe (Akzo Nobel), Kwal, Sherwin Williams, PPG Industries, or Pratt & Lambert.

B. All material shall be of the standard residential grade of the types designated.

C. All material shall be delivered to the job site in the original, unopened, labeled containers. Colors not specifically called for in the Paint Schedule will be selected by the Architect.

PART 3 - EXECUTION

3.1 WORK INCLUDED

A. Exterior Work:

1.	All exterior galvanized metal flashings, connectors, etc.	One coat commercial metal etch. One coat exterior metal primer. Two coats exterior semi-gloss metal paint.
2.	All exposed steel frames, angles, etc.	Two coats semi-gloss metal paint. (Prime coat channels, posts, railings, beams, etc. surfaces that are not primed.)
3.	All exposed misc. ferrous metal items including rails, plates, angles, bolts, grates, conduits, posts, piping, etc.	Two coats semi-gloss metal paint. (Prime coat surfaces that are not primed.)
4.	All unprimed exterior millwork, trim, smooth wood materials, etc. to receive paint	Prime and back latex primer. Two coats of exterior latex satin or semi-gloss paint.
5.	Primed millwork and trim.	Touch-up prime. Two coats of exterior 100% satin or semi-gloss acrylic latex paint.
6.	Primed metal entry doors, french doors and metal frames, garage doors.	Patch dents, touch up primer. Two coats of oil base semi-gloss paint inside and outside.
7.	Any other painting required by the Drawings.	Two coats to match adjacent surfaces.

B. Interior Work:

1.	Gypsum board walls unless scheduled for tile or wallcovering	One coat of color tinted primer. Two finish coat of latex flat wall paint. (final coat applied after 1st wall punch.) Two walls in each apartment unit shall be painted accent colors.
2.	Gypsum board walls in common area corridors	One coat of prime latex paint and one finish coat of scrubbable latex flat wall paint. (Two coats if required to achieve full coverage.)
4.	Gypsum board ceilings.	One coat color tinted primer. Two coats of latex flat paint.

6.	Doors, casings, base and millwork	One coat of primer. One finish coat of semi-gloss or eggshell enamel.
7.	All miscellaneous ferrous metal, including grilles, registers, etc.	Two coats metal paint to match adjacent surfaces unless factory prefinished white.
9.	Any other painting work required by the Drawings.	Finish to match similar conditions.

END OF SECTION 099100

SECTION 101400 SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Supply and install all signage, letters and numbers as shown on Drawings and as required by the authorities having jurisdiction as specified herein.

1.2 SAMPLES

A. Submit one sample of each type of signage material selected plus as many as required by Contractor. Mark with manufacturer's name and space where signage is to be installed.

1.3 GUARANTEE

A. Per GENERAL CONDITIONS.

1.4 COORDINATION

A. Coordinate all with other Trades whose Work affects signage installations. Before proceeding, make certain all required inspections have been made.

1.5 INSPECTION

A. Examine all subsurfaces to received Work and report in writing to General Contractor, with a copy to Architect, any conditions detrimental. Failure to observe this injunction constitutes a waiver to any subsequent claims to the contrary and holds Contractor responsible for any corrections Architect may require. Commencement of Work will be construed as acceptance of all subsurfaces

1.6 DELIVERY AND STORAGE

A. Deliver all manufactured materials in original packaging bearing name of manufacturer, brand and grade seals. Keep materials dry, clean and protected against deterioration in any form.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The Contractor shall furnish and install all required and necessary signage for the Project under an allowance of $3,000.00. This amount shall cover the cost of materials and labor to supply and install signage selected by the Owner only. Colors and Finishes shall be as selected by Owner.

B. This allowance amount shall not include amounts for Contractor's / Subcontractor's overhead and profit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor shall install all signage as directed by Owner or as required by authorities with jurisdiction over this project in strict accordance with the manufacturers printed instructions and directions.

B. Letters, Symbols and Numerals composing the signage shall comply with all applicable codes, ordinances and regulations of all governing bodies with jurisdiction over this project.

END OF SECTION 101400

SECTION 102800 TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Private-use bathroom accessories.
2. Public-use bathroom accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required
1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PRIVATE-USE BATHROOM ACCESSORIES

A. Apartment Bathroom accessory items shall be standard products of the Taymor Concepts unless otherwise noted.

1. Towel Bars shall be Sundial #01-20224, 24” long.
2. Towel rings shall be Sundial #01-204.
3. Robe Hooks shall be Sundial #01-212, twin robe hooks.
4. Toilet Paper Holders shall be Sundial #01-201S
5. Tub/Shower rods shall be #01-C9689, 60” long, crescent curved shower rods.
6. Grab bars for handicap accessible units shall be C2300 series, 1-1/2” O.D. satin heavy duty grab bars with concealed flanges.

2.2 PUBLIC-USE BATHROOM ACCESSORIES

A. Clubhouse Restroom accessory items shall be standard products of the Bradley Corporation unless otherwise noted.

1. Toilet Tissue (Roll) Dispenser; Model 5263 Double Roll
2. Soap Dispenser; Model 6A00-11 Surface-Mounted Liquid Tank Type Vertical
3. Grab Bar; 812 Series, 1-1/2-inch O.D. with concealed mounting
4. Mirror Unit; Model 740 Fixed Tilt Mirror
5. Coat Hook; Model 915 Hook and Bumper
6. Hand Dryer; Model 2902-2874 Adjustable Motor, Adjustable Sensor-Operated

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine substrates, previously installed inserts and anchorages necessary for mounting of toilet accessories, and other conditions under which installation is to occur, and must notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated. Adhesive installations are not permitted.

B. Mounting heights shall be as recommended by the accessory manufacturer and at heights recommended by use for physically handicapped to comply with the Americans with Disabilities Act.

C. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F446.

3.3 ADJUST AND CLEAN

A. Adjust accessories for proper operation and verify that mechanisms function smoothly.

B. Clean and polish all exposed surfaces after removing protective coatings.

END OF SECTION 102800

SECTION 104413 FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fire-protection cabinets for portable fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Subject to compliance with requirements, provide Architectural Series fire extinguisher cabinets as manufactured by Larsen’s Manufacturing or approved equal. Provide FS 2409-6R cabinets in rated walls.

B. Cabinet Construction: Rated/Nonrated.

C. Cabinet Material: Steel sheet.

D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surfaces with exposed trim face and wall return at outer edge. (backbend).

E. Cabinet Trim Material: Same material and finish as door.

F. Door Material: Extruded-aluminum shapes.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Acrylic sheet.

1. Acrylic Sheet Color: Clear transparent acrylic sheet.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

J. Accessories:

1. Identification: Lettering complying with authorities having jurisdiction, if required, for letter style, size, spacing, and location. Locate as directed by Architect.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER"

1) Location: Applied to cabinet glazing.
2) Application Process: Pressure-sensitive vinyl letters.
3) Lettering Color: Red.
4) Orientation: Vertical.

K. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
b. Color: As selected by Architect from manufacturer's full range.

2. Aluminum: ASTM B221 (ASTM B221M) for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.

a. Color: As selected by Architect from full range of industry colors and color densities.

3. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare recesses for recessed and semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.

B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

D. Identification: Apply vinyl lettering at locations indicated.

E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

SECTION 104416 FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Subject to compliance with requirements, provide Model MP 5 fire extinguishers as manufactured by Larsen's Manufacturing, or approved equal with mounting brackets.

1. Multi Provide wall semi-recessed cabinet mounted fire extinguisher in the Apartment building corridors as indicated and required by Fire Chief.

2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type: Larsens MP5 (2A:10B:C UL Rating) 5 Lbs. nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container, or equal by one of the above manufacturers.

C. Wet-Chemical Type: UL-rated 2-A:1-B:C:K, 2.5-gal. nominal capacity, with potassium acetate-based chemical in stainless steel container; with pressure-indicating gage.

1. Location: Clubhouse Kitchen.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction, if required, for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers and mounting brackets in locations indicated, and one in each apartment unit with all in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: Top of fire extinguisher to be at 54 inches above finished floor.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105500 POSTAL SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Supply and install Mailboxes as shown on the Drawings and as specified herein.

1.2 SHOP DRAWINGS

A. Submit brochures and Shop Drawings of all items showing sizes of members, methods of construction and mounting techniques.

1.3 SUBMITTALS

A. Submit manufacturer's specifications and installation instructions for mailbox units indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mailboxes shall be Versatile Model 4C12D-12 front loading mailboxes as manufactured by AF Florence Manufacturing Company or approved equal with powder coated finish in a color selected by the Architect. Mount units with the top mailbox lock at 54” AFF and provide full size 3/4” MDO plywood panels in the bottom of the parcel lockers to comply with the 15” AFF requirement. Provide complete with metal trim and mullions as required.

PART 2 - EXECUTION

3.1 PROCEDURES

A. Verify openings are properly sized and proper heights for an installation meeting federal requirements. Provide quantities as indicated on elevations.

B. Installation shall be per manufacturers’ recommendations for a proper and full installation. Provide proper trim and accessories for a complete installation.

C. Provide key combinations so no two keys are alike in this installation.

END OF SECTION 105500

SECTION 105700 WIRE SHELVING

PART 1 - GENERAL

1.1 SUMMARY

A. Supply and install all Wire Shelving as shown on the Drawings and as specified herein.

1.2 SHOP DRAWINGS

A. Submit brochures and Shop Drawings of all items showing sizes of members, methods of construction and mounting techniques.

1.3 COORDINATION

A. Coordinate with all other trades whose Work relates to items specified herein for placing of all required backing to insure proper locations.

1.4 DELIVERY AND STORAGE

A. Deliver and store all items specified herein in dry protected areas. Keep free of corrosion or other damage. Replace any damaged items at no cost to the Owner.

1.5 SUBMITTALS

A. Submit manufacturer's product data and installation instructions for approval.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All wire shelving shall be Schulte Corporation, Closet Maid or equal, constructed of PVC coated grade C1008 cold drawn steel rods with 100,000 psi tensile strength.

B. Wire shelving in walk-in closets and coat closets shall be 12" deep wire shelves with superslide hanging rods complete with all wall clips, end caps, anchors, etc. as required for a complete installation.

C. Wire shelving for linen storage in walk-in closets shall be (5) 15" deep x width indicated, fixed shelves complete with all wall clips, end caps, anchors, support poles, pole shelf support clips, etc. as required for a complete installation.

D. Wire shelving in all laundry rooms shall be (1) 12" deep x room width fixed shelf complete with all support brackets, anchors, end caps, etc. as required for a complete installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all wire shelving per manufacturer's written instructions.

END OF SECTION 105700

SECTION 107313 - AWNINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed awnings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, fabrication details, dimensions of individual components and profiles, hardware, fittings, mounting accessories, features, and finishes for awnings.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, mounting heights, and attachment details.
2. Detail fabrication and assembly of awnings.
3. Show locations for blocking, reinforcement, and supplementary structural support.

C. Samples: For each exposed product and for each color and texture specified.

D. Product Schedule: For awnings. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Sample Warranty: For special warranty.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of products.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.5 WARRANTY

A. Special Warranty: Manufacturer and fabricator agree to repair or replace components of awnings that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including framework.
    b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    c. Faulty operation of operator.

2. Awning Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 AWNING FRAME AND ACCESSORY MATERIALS

A. Steel:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Steel Tubing: ASTM A500/A500M.
3. Galvanized Steel Tubing: ASTM A787/A787M.
4. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40).

B. Aluminum: Alloy and temper recommended by awning manufacturer for type of use and finish indicated and with not less than the strength and durability properties of alloy and temper required by structural loads.

1. Aluminum Plate and Sheet: ASTM B209.
2. Aluminum Extrusions: ASTM B221.
3. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, standard weight (Schedule 40).
4. Drawn Seamless Tubing: ASTM B210.

C. Anchors, Fasteners, Fittings, Hardware, and Installation Accessories: Complying with performance requirements indicated and suitable for exposure conditions, supporting structure, anchoring substrates, and installation methods indicated. Corrosion-resistant or noncorrodible units; weather-resistant, tamperproof, vandal- and theft-resistant, compatible, nonstaining materials. Provide as required for awning assembly, mounting, and secure attachment. Number as needed to comply with performance requirements and to maintain uniform appearance; evenly spaced. Where exposed to view, provide finish and color as selected by Architect from manufacturer's full range.

1. Wood Screws: ASME B18.6.1.
2. Lag Bolts: ASME B18.2.1.
3. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M,Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers, zinc coated.

4. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing according to ASTM E488 conducted by a qualified independent testing and inspecting agency.

    a. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

5. Adhesive-Bonded Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing according to ASTM E1512 conducted by a qualified independent testing and inspecting agency.

    a. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

2.3 FIXED AWNINGS

A. Fixed Awnings:

1. Frame Fabrication: Fabricate awning frames from aluminum. Preassemble in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
2. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
3. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Fabricate slip-fit connections exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
4. Weld corners and connections continuously. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed corners and connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
5. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure awnings in place and to properly transfer loads.

B. Aluminum Finish: Baked-enamel or powder-coat finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for supporting members, blocking, inserts, installation tolerances, lighting, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install awnings at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Use mounting methods of types described and in compliance with Shop Drawings and fabricator's written instructions.

B. Install awnings after other finishing operations, including joint sealing and painting, have been completed.

C. Slip fit frame connections accurately together to form hairline joints, and tighten to secure.

D. Weld frame connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

1. Field Welding: Comply with the following requirements:

a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
b. Obtain fusion without undercut or overlap.
c. Remove welding flux immediately.
d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. Anchoring to In-Place Construction: Use anchors, fasteners, fittings, hardware, and installation accessories where necessary for securing awnings to structural support and for properly transferring load to in-place construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

G. Coordinate awning installation with flashing and joint-sealant installation so these materials are installed in sequence and in a manner that prevents exterior moisture from passing through completed exterior wall and roof assemblies.

3.3 CLEANING AND PROTECTION

A. Touch up factory-applied finishes to restore damaged or soiled areas.

B. Galvanized Surfaces: Clean field welds, connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION 107313

SECTION 113100 APPLIANCES AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cooking appliances.
2. Kitchen exhaust ventilation.
3. Refrigeration appliances.
4. Cleaning appliances.
5. Clubhouse appliances.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Submit Shop Drawings of all work specified herein showing sizes, methods of installation and mounting requirements, including rough-in and connection details for electrical, plumbing, and ventilation, catalog cuts, brochures, and operating characteristics of all items.

C. Submit equipment data, floor plans and shop details with the clear understanding that no fabrication or ordering of equipment shall proceed until equipment and drawings have been approved by Architect.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

B. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Gas-Fueled Appliances: Certified by a qualified testing agency for each type of gas-fueled appliance according to ANSI Z21 Series standards.

C. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and ICC A117.1.

2.2 MATERIALS

A. The following appliances shall be furnished and installed by the Contractor. Work shall include setting-in-place all appliances and all electrical, mechanical and plumbing hook-ups to make a complete and first-class installation. Kitchen appliances shall be stainless steel and Laundry appliances shall be white. Appliances listed are as manufactured by General Electric unless otherwise noted.

Apartment Units: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.

1.	Refrigerator w/ Icemaker	GWE19JYLFS
2.	Electric Range	JBS60RKSS
3.	Over-The-Range Microwave	JNM7196SKSS Non-Vented
4.	Dishwasher (Under Counter)	GDT650SYVFS
5.	Unitized Washer/Dryer Combo	GUD27EESNWW
6.	Washer	GFW550SSNWW
7.	Dryer	GFD55ESSNWW
	(Provide ‘Dryer Box’ and commercial grade dryer vent caps)	

Type ‘A’ Accessible Apartments: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.

1.	Refrigerator w/ Icemaker	GYE18JYLFS
2.	Electric Range	JS645SLSS
3.	Over-The-Range Microwave *	JNM7196SKSS Non-Vented
4.	Dishwasher (Under Counter)	GDT226SSL
5.	Washer	GFW550SSNWW
6.	Dryer	GFD55ESSNWW
	(Provide ‘Dryer Box’ and commercial grade dryer vent caps)	

B. *Vent and light on the over-the-range microwave shall be controlled from wall switches mounted at accessible height.

C. Products manufactured by Whirlpool or approved equal, will be considered. Washer and dryer dimensions will be considered in the review of comparable products.

D. Apartment unit dryer boxes shall be Model 350 as manufactured by In-O-Vate, or approved equal with an F rating of 1-HR and a T rating of 0.5-HR.

E. Apartment Unit washing machine boxes shall be 696R Series OxBox by Sioux Chief, or approved equal with an F rating of 1-HR and a T rating of 0.5-HR.

F. Clubhouse Appliances:

1. Under Cabinet Refrigerators: GME04GLKLB

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

C. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

D. Utilities: Comply with plumbing and electrical requirements.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Operational Test: After installation, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. Cleaning:

1. Prior to final acceptance, clean all equipment and remove all stains, paint spots, protective wrappings and coatings, tapes, grease, oil, plaster, dust, polishing compounds and install all internal components and accessories.

C. After installation, provide maintenance manuals, operating instructions, replacement parts list, serial and model numbers and registry cards for each item of equipment.

END OF SECTION 113100

SECTION 122110 DOOR AND WINDOW BLINDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Horizontal louver blinds with polymer slats.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.1 MEASUREMENTS

A. Verify all dimensions shown on drawings by taking field measurements. Proper fit and attachment of all parts is required.

1.2 COORDINATION

A. Coordinate and cooperate with all trades whose Work relates in any way to items specified herein so Work progresses smoothly and without delay.

1.3 INSPECTION

A. Examine all subsurfaces to receive Work and report in writing to General Contractor, with a copy to Architect any conditions detrimental to Work. Failure to observe this injunction constitutes a waiver to any subsequent claims to the contrary and makes contractor responsible for any corrections Architect may require. Commencement of Work will be construed as acceptance of all subsurfaces.

1.4 ANCHORAGE

A. Furnish and install all anchorage devices required to install the item and its appurtenances, complete. Provide anchorage in ample time when required to be built in by other trades.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. MANUFACTURERS

Bali, Graber, Levelor, or approved equal.

B. HORIZONTAL BLINDS - Apartment unit windows and fixed to swinging patio doors.

1. 2 inch faux wood slats
2. Faux wood top and bottom rails
3. Cord-Lock operation to stop blinds at any position
4. Manual tilt wand operation
5. Self-aligning cord equalizer
6. Color to be selected by the Architect from standard color palette

2.1 HORIZONTAL LOUVER BLIND FABRICATION

A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch. Length equal to head-to-sill dimension of opening in which blind is installed less 1/4 inch, plus or minus 1/8 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

1. Install mounting and intermediate brackets to prevent deflection of headrails.
2. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

C. Adjust blinds to operate free of binding or malfunction through full operating ranges.

D. Clean blind surfaces after installation according to manufacturer's written instructions.

END OF SECTION 122110

SECTION 123530 CABINETRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Kitchen cabinets.
2. Vanity cabinets.
3. Clubhouse cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cabinets.
2. Cabinet hardware.

B. Shop Drawings: For cabinets and countertops. Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, hardware, edge and backsplash profiles, methods of joining countertops, and cutouts for plumbing fixtures.

C. Samples: For each type and finish of material exposed to view.

1.3 DELIVERY AND STORAGE

A. Deliver and store all items in dry, protected areas. Keep free of corrosion or other damage. Replace any damaged items, or parts, at no cost to Owner.

1.4 COORDINATION

A. Coordinate and cooperate with all trades whose Work relates in any way to items specified herein so Work progresses smoothly and without delay.

1.5 INSPECTION

A. Examine all subsurfaces to receive Work and report in writing to General Contractor, with a copy to Architect any conditions detrimental to the installation of cabinetry. Failure to observe this injunction constitutes a waiver to any subsequent claims to the contrary and makes contractor responsible for any corrections the Architect may require. Commencement of Work will be construed as acceptance of all subsurfaces

1.6 ANCHORAGE

A. Furnish and install all anchorage devices required to install the item and its appurtenances, complete. Provide anchorage in ample time when required to be built in by other trades.

1.7 QUALITY ASSURANCE

A. All cabinets shall meet or exceed the recommended minimum construction and performance standards of the National Kitchen Cabinet Association and ANSI A161.1.

PART 2 - PRODUCTS

2.1 CABINETS

A. Subject to compliance with requirements, cabinetry shall be as indicated, Contractor's Choice, as supplied by MasterBrand Cabinets, Inc. or approved equal products supplied by Kountry Wood Products or Mid America Cabinets. Cabinet style and finish shall be as selected by the Owner.

B. Handicapped Units shall be provided with kitchen cabinets in locations shown and vanity cabinets in bathrooms that are partially removable to allow for wheelchairs to roll under sink in case of handicapped occupant.

2.2 CABINET HARDWARE

A. General: Manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected by Architect from manufacturer's full range.

B. Pulls: Decorative pulls as selected by the Owner.

C. Hinges: Concealed adjustable self-closing hinges.

D. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05011 or B05091.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cabinets with no variations in flushness of adjoining surfaces; use concealed shims. Where cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.

B. Install cabinets without distortion so doors and drawers fit openings, are aligned, and are uniformly spaced. Complete installation of hardware and accessories as indicated.

C. Install cabinets level and plumb to a tolerance of 1/8 inch in 8 feet.

D. Fasten cabinets to adjacent units and to backing.

1. Fasten wall cabinets through back, near top and bottom, at ends and not less than 24 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

E. Adjust cabinets and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

F. Protect finished surfaces from damage or staining resulting from subsequent work. Repair or replace damaged cabinetwork, including warped or loose members.

G. Caulk all joints between kitchen and vanity countertops and walls and joints between plumbing fixtures and countertops.

END OF SECTION 123530

SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.
2. Quartz agglomerate backsplashes.
3. Quartz agglomerate end splashes.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples: For each type of material exposed to view.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of polymers, resins, and pigment and complying with ISFA 3-01.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cambria.
b. Cosentino North America; C&C North America, Inc.
c. DuPont; DuPont de Nemours, Inc.
d. LG Hausys, Ltd.
e. Lotte Chemical Co., LTD.
f. Meganite Inc.
g. TechniStone; Wilsonart LLC.

2. Colors and Patterns: As selected by Architect from manufacturer's full range.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops: 3/4-inch- thick, quartz agglomerate with front edge built up with same material.

D. Backsplashes: 3/4-inch- thick, quartz agglomerate.

E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

F. Joints:

1. Fabricate countertops without joints.
2. Fabricate countertops in sections for joining in field.

a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
b. Joint Type, Bonded: 1/32 inch or less in width.
c. Joint Type, Grouted: 1/16 inch in width.
d. Joint Type, Sealant Filled: 1/16 inch in width.
e. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

G. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
b. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.
c. Provide 3/4-inch full bullnose edges projecting 3/8 inch into fixture opening.

2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.
4. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.19

SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE SUPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 210516 "Expansion Fittings and Loops for Fire-Suppression Piping" for pipe guides and anchors.

1.2 ACTION SUBMITTALS

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Comply with NFPA 13 .

B. UL Compliance: Comply with UL 203.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel .

2.3 MATERIALS

A. Aluminum: ASTM B 221 .

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi , 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

C. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

D. Install lateral bracing with pipe hangers and supports to prevent swaying.

E. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

F. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for .

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use thermal hanger-shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 .
2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 .
4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 .
5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 .
6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 .
7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 , with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 , with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 .
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Comply with NFPA requirements.

K. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. C-Clamps (MSS Type 23): For structural shapes.
2. Side-Beam Brackets (MSS Type 34): For sides of steel Purlins.

L. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

M. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

END OF SECTION 210529

SECTION 210533 - HEAT TRACING FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes heat tracing for fire-suppression piping with the following electric heating cables:

1. Self-regulating, parallel resistance.

B. Related Requirements:

1. Section 210700 "Fire Suppression Systems Insulation."
2. Section 220533 "Heat Tracing for Plumbing Piping."
3. Section 230533 "Heat Tracing for HVAC Piping."
4. Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
5. Section 260526 "Grounding and Bonding for Electrical Systems."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include:
   a. Heating cable data sheet.
   b. Fire sprinkler freeze protection design guide.
   c. System installation and operation manual.
   d. System installation details.
   e. Connection kits and accessories data sheet.
   f. Controller data sheet.
   g. Controller wiring diagram.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Schedule heating capacity, length of cable, and electrical power requirement for each electric heating cable required.
4. Include heat loss calculations for each pipe including pipe and insulation characteristics, heat loss, and watts per foot supplied by the heating cable.

B. Shop Drawings: For electric heating cable.

1. Include plans, elevations, sections, and attachment details.

2. Include diagrams for power, signal, and control wiring.
3. Manufacturer to produce detailed design as described below.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Delegated design submittals include:

1. Heat Trace Circuit Layout Drawings, including:
   a. Location/Identification of area to be traced.
   b. Heater circuit number.
   c. Electrical load.
   d. Heater catalog numbers.
   e. Heater termination points.
   f. Start-up temperature.
   g. Location of all components.
   h. Material list and quantities of all components.
   i. Heating cable layout.
2. Heat Trace Isometric, including:
   a. Location of line.
   b. Piping line numbers.
   c. Valves, pumps, flanges, fittings, instruments.
   d. Heat loss and heater output.
   e. Electrical load.
   f. Heater catalog number.
   g. Heater termination points.
   h. Design parameters.
   i. Insulation type and thickness.
   j. Position of all components.
   k. Material schedule listing all components and quantities used.
   l. Panel ID number.
3. Pipe Freeze Protection Detail Drawings: Project-specific Detail Drawings, including details showing:
   a. Installation and positioning of all components.
   b. Proper amounts of tracing for valves, pumps, flanges, fittings, instruments, etc.
   c. Junction box layouts.
4. Control Panel Drawings: Drawings for each control panel shall include the following:
   a. Physical arrangement and structural detail drawings.
   b. Complete power and control wiring diagrams showing all internal wiring connections for electrical and instrument components in each control panel. All wires, terminals, and devices shall be numbered and tagged in accordance with system elementary diagrams.
5. System Wiring Diagram: Project-specific drawings (if applicable) including:
   a. Interconnect of all major components.
   b. Assignment of circuiting.
   c. Connection of circuit wiring in terminal blocks.
   d. Connection of sensor wiring.
   e. Connection of external alarm wiring.
6. Controller Setpoint Schedule (if applicable) showing the following:
   a. Circuit addresses.
   b. Circuit set points.
   c. Circuit alarms and settings.

D. Testing Instructions and Reporting Form: Provide documentation for use in preinstallation testing of heat-tracing system.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

B. Testing: Completed system test report.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. ISO-09001 registered.
2. Provide Products with CSA 22.2 No 130-16 certification and/or UL 515 listing, consistent with IEEE 515.1 requirements.

B. Installer Qualifications:

1. System Installer to have complete understanding of product and product literature from manufacturer or authorized representative prior to installation.
2. Electrical connections to be performed by licensed electrician.

C. Certification: System (Heating Cable, Connection Kits, and Controller): CSA Certified for freeze protection of standpipes, mains, and branch fire sprinkler piping.

D. Testing: Self-regulating heating cable to be qualified and tested to demonstrate a useful lifetime in excess of 20 years.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying the following:

1. Product and Manufacturer.
2. Length/Quantity.
3. Lot Number.
4. Installation and operation Manual.
5. Material Safety Data Sheet (MSDS).

B. Store heating cable in clean, dry location with a temperature range of 0 to 140 deg F.

C. Protect heating cable ends from moisture ingress until final termination of the heating cable is complete.

1.8 WARRANTY

A. Manufacturer Limited Warranty: Manufacturer agrees to repair or replace heat tracing products listed below that fail in materials or workmanship within specified warranty period, when such goods are properly installed, operated, and maintained in accordance with product documentation.

1. Covered Products Include:
   a. Heating cables, connection kits, and accessories.
   b. Thermostats, controllers, panels, contactors, sensors, and accessories.
2. Warranty Period: Two years from date of Substantial Completion.

B. Manufacturer's Extended Warranty: Provide Owner an extended product warranty for heat-tracing products described below.

1. Contractor must complete and forward to Owner the Installation, Inspection, or Commissioning Record(s), and complete manufacturer’s online warranty registration form within 30 days from date of installation, otherwise only standard limited warranty applies.
2. Heating Cable Warranty Period: 10 years from date of Substantial Completion.
3. Heating cables, connection kits and accessories not automatically offered with a 10-year manufacturer's warranty, as a standard matter of course, will not be allowed. Warranty information must be published on the manufacturer's website.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Complete pipe freeze protection system for insulated pipes exposed to the risk of freezing. System consists of a self-regulating heating cable, connection kits, accessories, and energy-efficient control and monitoring controller. The heating cable shall have a polyolefin jacket for aboveground fire sprinkler piping, including standpipes, mains, and branch fire sprinkler piping,

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage manufacturer to design complete and functional heat-tracing system as required by Project documents.

2.3 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide RAYCHEM, a brand of nVent; XL-Trace Pipe Freeze/Flow Maintenance or comparable product by one of the following:

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1. DELTA THERM .

B. Source Limitations: Obtain heat-tracing components and controllers from single manufacturer. To ensure system integrity and meet warranty requirements, only components and controllers supplied by cable manufacturer are to be used.

C. Comply with UL 515A, CSA 22.2 No 130-16, and IEEE 515.1 requirements.

D. Heating Element: Pair of parallel No. 16 AWG, nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end with a watertight end seal. Cable shall be capable of crossing over itself once without overheating.

E. Electrical Insulating Jacket: Flame-retardant modified polyolefin.

F. Ground Braid: Tinned-copper braid. Minimum 70 percent for ground path and mechanical ruggedness.

G. Outer Jacket: Modified polyolefin with ultraviolet inhibitor**.** Outer jacket to be printed with cable model number, agency listings, batch number, and meter marks (for ease of installation within maximum circuit length).

H. Maximum Operating Temperature (Power On): 150 deg F.

I. Maximum Exposure Temperature (Power Off): 150 deg F.

J. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

K. Capacities and Characteristics:

1. Maximum Heat Output at 50 deg F: 8 W/ft. .
2. Piping Diameter: 4" .
3. Electrical Characteristics for Single-Circuit Connection:
   a. Volts: 208 .
   b. Phase: Single.

2.4 HEATING CABLE CONNECTION KITS

A. Basis-of-Design Product: RAYCHEM; RayClic.

B. Provide power connections, splices/tees, and end seal kits to properly connect and terminate heating cable circuit along specified length of piping.

C. Install splices, tees, and crosses underneath pipe insulation with service loops installed to allow for future service of piping.

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D. Connection kits shall be rated NEMA 4X to prevent water ingress and corrosion. All components shall be UV stabilized and shall not require cutting into heating-cable core to expose bus wires.

E. Certification: UL Listed, CSA Certified, and FM approved.

F. Locate connection kits above grade for buried applications.

2.5 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, cable ties, connection kits, and end seals all furnished by manufacturer or as recommended in writing by manufacturer.

B. Identification: Provide and install "Electric Heat Traced" labels on exterior of pipe insulation every 10 ft. on opposite sides of pipe, and on all splices, tees, crosses, and power connections for the entire length of heat traced piping.

C. Thermal Pipe Insulation:

1. Pipes to be thermally insulated in accordance with manufacturer's written requirements.
2. Thermal Insulation: Flame retardant, fiberglass with waterproof covering.

2.6 SYSTEM APPROVAL

A. Complete heat trace system (heating cable, connection kits, and controller) shall be listed by a Nationally Recognized Testing Laboratory (NRTL), and marked for intended freeze protection of standpipes, mains, and branch fire sprinkler piping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Prior to installation of heating cable system, verify that all piping, to be heat traced has passed all hydrostatic/pressure test and is signed off by plumbing inspector.
2. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.

B. Preinstallation Testing:

1. Prior to installation of heating cable on piping, an insulation resistance test shall be performed by installing contractor to ensure integrity of heating cable as describe in installation and maintenance manual.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

A. Protect all heating cable ends from moisture ingress until cable is terminated with end seals.

1. Basis-of-Design Product: RAYCHEM; RayClic-E end seals.

3.3 INSTALLATION

A. Install electric heating cable where indicated and in accordance with NFPA 70 and NFPA 13.

B. All heat-tracing components including power connections, splices, tees, and crosses or end seal, must be installed above grade and protected from abuse or damage. In accordance with NEC and CEC, electrical connections are not permitted to be installed below grade.

C. In the field, all heating cables shall be meggered with a minimum of 2,500 V dc for self-regulating cable. The following field megger readings shall be taken on each heating cable:

1. Heating cable shall be meggered when received at Project site before installation.
2. Heating cable shall be meggered after installation, but before insulation is installed.
3. Heating cable shall be meggered after insulation is installed.
4. Heating cable shall be meggered at final commissioning prior to being energized.
5. Insulation resistance must exceed 1.000 megohms at 2,500 V dc.
6. All results must meet manufacturer's specification.

D. Install electric heating cables after piping has passed all hydrostatic pressure testing and before insulation is installed.

E. Install electric heating cables in accordance with IEEE 515.1.

F. Install insulation over piping with electric cables in accordance with Section 210700 "Fire-Suppression Systems Insulation."

G. Install warning tape on piping insulation where piping is equipped with electric heating cables.

H. Set field-adjustable switches and circuit-breaker trip ranges.

3.4 CONNECTIONS

A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Initial start-up and field testing (commissioning) of system shall be performed by factory technician in accordance with Owner's requirements.

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1. System shall be commissioned in accordance with manufacturer's installation and operation manual.
2. Field Visits to be scheduled at the following intervals:
   a. Preinstallation training.
   b. Final electrical insulation resistance (megger) testing of heating cable after insulation has been installed.
   c. Final commissioning including controller programming (if applicable).
3. Technician to verify:
   a. Controller parameters are set to the application requirements.
   b. Controller alarm contacts are properly connected to the BMS, as applicable.

B. Contractor to perform the following tests and inspections during installation:

1. Heating cable shall be meggered when received at Project site before installation.
2. Heating cable shall be meggered after installation, but before insulation is installed.
3. Heating cable shall be meggered after insulation is installed.
   a. Insulation resistance must exceed 1,000 megohms at 2,500 V dc.
4. All results must meet manufacturer's specification.
5. Test cables for electrical continuity during installation.
6. Test insulation integrity before energizing.
7. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

C. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

D. Cables will be considered defective if they do not pass tests and inspections in accordance with manufacturer's testing requirements.

E. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed heating cables, including nonheating leads, from damage and moisture ingress during construction.

B. Remove and replace damaged heat-tracing cables.

END OF SECTION 210533

SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through floor into the building and the following:

1. Pipes, fittings, and specialties.
2. Fire-suppression specialty valves.
3. Protective enclosures.
4. Alarm devices.

B. Related Requirements:

1. Section 211119 "Fire-Department Connections" for exposed-, flush-, and yard-type, fire-department connections.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying the water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with FM Global's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.

C. Grooved-End, Ductile-Iron Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International.
   b. Tyco by Johnson Controls Company.
   c. Victaulic Company.
2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

D. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

E. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.

1. Gaskets: AWWA C111, rubber.

F. Flanges: ASME B16.1, Class 125, cast iron.

2.2 PVC PIPE AND FITTINGS

A. PVC Pipe: AWWA C900 or , Class 200, with bell end with gasket, and with spigot end.

B. PVC Fittings: AWWA C900 or , Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

2.3 JOINING MATERIALS

A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.

2.4 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.5 BACKFLOW PREVENTERS

A. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Ames Fire & Waterworks; A WATTS Brand.
   b. FEBCO; A WATTS Brand.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1015 or AWWA C510.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

B. Double-Check, Detector-Assembly Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Ames Fire & Waterworks; A WATTS Brand.
   b. FEBCO; A WATTS Brand.
   c. Mueller Co.
2. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or FM Global's "Approval Guide."
3. Operation: Continuous-pressure applications.
4. End Connections: Flanged.
5. Accessories:
   a. Valves: UL 262 and FM Global's "Approval Guide" listing; OS&Y gate type with flanged ends on inlet and outlet.
   b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

2.6 ALARM DEVICES

A. General: UL 753 and FM Global's "Approval Guide" listing, of types and sizes to mate and match piping and equipment.

B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig working pressure; designed for horizontal or vertical installation; with two single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.

C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Water-Main Connection: Arrange with water utility company for tap of size and in location indicated in water main.

B. Comply with NFPA 24 for fire-service-main piping materials and installation.

C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

1. Install encasement for piping according to ASTM A 674 or AWWA C105.

D. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

E. Bury piping with depth of cover over top at least 48 , with top at least 12 inches below level of maximum frost penetration, and according to the following:

1. Under Driveways: With at least 36 inches of cover over top.
2. In Loose Gravelly Soil and Rock: With at least 12 inches of additional cover.

F. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

G. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.

1. Terminate fire-suppression water-service piping within the building at the floor slab until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.

H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

I. Comply with requirements in Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

J. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

K. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in tubing NPS 2 and smaller.

C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of tubes and remove burrs.

E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

F. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

G. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.

H. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

I. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139.

J. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

K. Do not use flanges or unions for underground piping.

3.4 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.
6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL-Listed or FM Global-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL-Listed or FM Global-Approved Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. Install full-size valved bypass.

H. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers in Section 033000 "Cast-in-Place Concrete."

3.6 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support 2-1/2 NPS and larger backflow preventers and piping on concrete piers. Comply with requirements for concrete piers in Section 033000 "Cast-in-Place Concrete."

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install ball drip valves at each check valve for fire-department connection to mains.

B. Install protective pipe bollards on three sides of each freestanding fire-department connection. Pipe bollards are specified in Section 055000 "Metal Fabrications."

3.8 ALARM DEVICE INSTALLATION

A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.

B. Supervisory Switches: Supervise valves in open position.

1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.

C. Locking and Sealing: Secure unsupervised valves as follows:

1. Valves: Install chain and padlock on open OS&Y gate valve.
2. Post Indicators: Install padlock on wrench on indicator post.

D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.

E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.

F. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Section 284621.13 "Conventional Fire-Alarm Systems."

3.9 CONNECTIONS

A. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.10 FIELD QUALITY CONTROL

A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure or a minimum of 200 psi. for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to zero psig . Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare test and inspection reports.

3.11 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel. Comply with requirements for identifying devices in Section 220553 "Identification for Plumbing Piping and Equipment."

3.12 PIPING SCHEDULE

A. Underground fire-suppression water-service piping NPS 6 to NPS 12 shall be one of the following:

1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and gasketed joints.
3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and gasketed joints.
4. PVC, Class 200 pipe listed for fire-protection service; PVC fittings of same class as pipe; and gasketed joints.

3.13 VALVE SCHEDULE

END OF SECTION 211100

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Specialty valves.
4. Sprinklers.
5. Manual control stations.
6. Pressure gauges.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Design Data:

1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
   a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13 NFPA 13R.

C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

D. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Sprinkler system design shall be approved by authorities having jurisdiction.
   a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
   b. Sprinkler Occupancy Hazard Classifications:
      1) Building Service Areas: Ordinary Hazard, Group 1 .
      2) Electrical Equipment Rooms: Ordinary Hazard, Group 1 .
      3) General Storage Areas: Ordinary Hazard, Group 1 .
      4) Mechanical Equipment Rooms: Ordinary Hazard, Group 1 .
      5) Office and Public Areas: Light Hazard .
      6) Residential Living Areas: Light Hazard .
2. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Residential (Dwelling) Occupancy: 0.05 gpm over 400-sq. ft. area.
   b. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
   c. Ordinary-Hazard, Group 1 Occupancy: area.
   d. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
3. Maximum protection area per sprinkler according to UL listing.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Galvanized- and Black- Steel Pipe: ASTM A53/A53M, Type E , Grade B . Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Galvanized- and Black- Steel Pipe: ASTM A135/A135M; ASTM A795/A795M, Type E ; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Thinwall Galvanized- and Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

D. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

E. Nonstandard OD, Thinwall Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M thinwall with plain ends and wall thickness less than Schedule 10.

F. Hybrid Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5.

G. Schedule 5 Steel Pipe: ASTM A135/A135M or ASTM A795/A795M lightwall with plain ends.

H. Galvanized- and Black-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.

I. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

J. Cast-Iron Flanges: ASME 16.1, Class 125.

K. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
   a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
   b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

L. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International.
   b. Tyco by Johnson Controls Company.
   c. Victaulic Company.
2. Pressure Rating: 250-psig minimum.
3. Galvanized Painted Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 CPVC PIPE AND FITTINGS

A. CPVC Pipe: ASTM F442/F442M and UL 1821, SDR 13.5, for 175-psig rated pressure at 150 deg F, with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.

B. CPVC Fittings: UL listed or FM Global approved, for 175-psig rated pressure at 150 deg F, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.

1. NPS 3/4 to NPS 1-1/2: ASTM F438 and UL 1821, Schedule 40, socket type.
2. NPS 2 to NPS 3: ASTM F439 and UL 1821, Schedule 80, socket type.
3. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
4. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.

C. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493 solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.

D. Plastic Pipe-Flange Gasket and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 COVER SYSTEM FOR SPRINKLER PIPING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. DecoShield Systems, Inc.

B. Description: System of support brackets and covers made to protect sprinkler piping.

C. Brackets: Glass-reinforced nylon.

D. Covers: Extruded-PVC sections of length, shape, and size required for size and routing of CPVC piping.

2.5 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Specialty Valves Pressure Rating: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Tyco by Johnson Controls Company.
   b. Victaulic Company.
   c. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.

G. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Reliable Automatic Sprinkler Co., Inc. (The).
   b. Tyco by Johnson Controls Company.
2. Standard: UL 1726.
3. Pressure Rating: 175-psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.6 AIR VENT

A. Manual Air Vent/Valve:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AGF Manufacturing, Inc.
   b. Shurjoint; a part of Aalberts Integrated piping Systems.
   c. Victaulic Company.
2. Description: Ball valve that requires human intervention to vent air.
3. Body: Forged brass.
4. Ends: Threaded.
5. Minimize Size: 1/2 inch.
6. Minimum Water Working Pressure Rating: 300 psig.

B. Automatic Air Vent:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AGF Manufacturing, Inc.
   b. CLA-VAL.
   c. Engineered Corrosion Solutions.
2. Description: Automatic air vent that automatically vents trapped air without human intervention.
3. Standard: UL listed or FM Global approved for wet-pipe fire sprinkler systems.
4. Vents oxygen continuously from system.

5. Float valve to prevent water discharge.
6. Minimum Water Working Pressure Rating: 175 psig.

2.7 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International.
   b. Tyco by Johnson Controls Company.
   c. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175-psig minimum .
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Reliable Automatic Sprinkler Co., Inc. (The).
   b. Tyco by Johnson Controls Company.
   c. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum .
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AGF Manufacturing, Inc.
   b. Potter Electric Signal Company, LLC.
   c. Potter Roemer LLC; a Division of Morris Group International.
2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.

7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Tyco by Johnson Controls Company.
   b. Victaulic Company.
   c. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 300 psig.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aegis Technologies, Inc.
   b. CPS Products, Inc.
   c. Merit Manufacturing.
2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum .
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. ALEUM USA.
   b. FlexHead Industries, Inc.
   c. Victaulic Company.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum .
5. Size: Same as connected piping, for sprinkler.

2.8 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Reliable Automatic Sprinkler Co., Inc. (The).
2. Tyco by Johnson Controls Company.
3. Victaulic Company.
4. Viking Corporation.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Residential Sprinklers: 175-psig maximum.

D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

E. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767 .
2. Nonresidential Applications: UL 199 .
3. Residential Applications: UL 1626 .
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

F. Sprinkler Finishes: Chrome plated bronze .

G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment .
2. Sidewall Mounting: Chrome-plated steel , one piece, flat.

H. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Reliable Automatic Sprinkler Co., Inc. (The).
   b. Tyco by Johnson Controls Company.
   c. Victaulic Company.
   d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.9 MANUAL CONTROL STATIONS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.

B. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.10 PRESSURE GAUGES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AGF Manufacturing, Inc.
2. AMETEK, Inc.
3. Ashcroft Inc.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gauge Range: 0- to 250-psig minimum .

E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping."

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

L. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.

M. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices .

N. Fill sprinkler system piping with water.

O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

N. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.

3.4 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

E. Air Vent:

1. Provide at least one air vent in each wet pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
2. Provide dielectric union for dissimilar metals, ball or globe valve, and strainer upstream of automatic air vent.
3. Pipe from outlet of air vent to drain.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.10 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. CPVC pipe, Schedule 40 Schedule 80 CPVC fittings, and solvent-cemented joints may be used for light-hazard and residential occupancies.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller , shall be one of the following:

1. Standard-weight , black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. , galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. , black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
4. , galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.

5. Standard-weight , black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
6. , galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
8. black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 , shall be one of the following:

1. Standard-weight , black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. , galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. , black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Standard-weight , galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

F. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger , shall be the following:

1. Standard-weight , black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. , galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Standard-weight , black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. , galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers .
2. Rooms with Suspended Ceilings: Pendent sprinklers Recessed sprinklers .
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated .
5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated .

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Residential Sprinklers: Dull chrome.
5. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Grout.
3. Silicone sealants.

1.2 ACTION SUBMITTALS

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. GE Construction Sealants; Momentive Performance Materials Inc.
   b. Sherwin-Williams Company (The).
   c. The Dow Chemical Company.
2. Verify sealant has a VOC content of 250 g/L or less.
3. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at

pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
   a. Piping Smaller Than NPS 6 : Steel pipe sleeves .
2. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6 : Steel pipe sleeves with sleeve-seal system .
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6 : Steel pipe sleeves .
4. Interior Partitions:
   a. Piping Smaller Than NPS 6 : Steel pipe sleeves .

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.2 ACTION SUBMITTALS

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. BrassCraft Manufacturing Co.; a Masco company.
2. Dearborn Brass.
3. Jones Stephens Corp.
4. Keeney Manufacturing Company (The).
5. Mid-America Fittings, Inc.
6. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
   b. Chrome-Plated Piping: One-piece steel or split-casting brass with polished, chrome-plated finish.
   c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
   d. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
   f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
   h. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping : Split floor plate.

END OF SECTION 220518

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder-joint connections.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Handlever: For quarter-turn valves smaller than NPS 4 .

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, One-Piece:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo.
   b. Crane.
   c. Jomar.
   d. KITZ Corporation.
2. Description:
   a. Standard: MSS SP-110.
   b. CWP Rating: 400 psig.
   c. Body Design: One piece.
   d. Body Material: Forged brass or bronze.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass or stainless steel.
   h. Ball: Chrome-plated brass or stainless steel.
   i. Port: Reduced.

B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Crane; a Crane brand.
   c. Jomar Valve.
   d. NIBCO INC.
   e. WATTS.
2. Description:
   a. Standard: MSS SP-110 or MSS SP-145.
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass.
   h. Ball: Chrome-plated brass.
   i. Port: Full.

C. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.

b. Crane; a Crane Co. brand.
c. Jomar Valve.
d. KITZ Corporation.
e. NIBCO INC.

2. Description:
a. Standard: MSS SP-110 or MSS SP-145.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Press.
f. Press Ends Connection Rating: Minimum 200 psig.
g. Seats: PTFE or RPTFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.
k. O-Ring: Buna-N or EPDM.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, One-Piece:

1. Manufacturers: Subject to compliance with requirements, undefined:
a. Apollo Flow Controls; Conbraco Industries, Inc.
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS.

2. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 400 psig.
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, undefined:
a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. WATTS.
e. Zurn Industries, LLC.

2. Description:
a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.

d. Body Material: Bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

C. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Crane; a Crane brand.
   c. NIBCO INC.
   d. WATTS.
   e. Zurn Industries, LLC.
2. Description:
   a. Standard: MSS SP-110 or MSS-145.
   b. CWP Rating: Minimum 200 psig.
   c. Body Design: Two piece.
   d. Body Material: Bronze.
   e. Ends: Press.
   f. Press Ends Connections Rating: Minimum 200 psig.
   g. Seats: PTFE or RTPFE.
   h. Stem: Bronze or brass.
   i. Ball: Chrome-plated brass.
   j. Port: Full.
   k. O-Ring Seal: EPDM or Buna-N.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3.3 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valves, one piece.
3. Bronze ball valve, one piece with bronze trim.
4. Brass ball valves, two-piece with full port and brass trim.
5. Bronze ball valves, two-piece with full port and bronze or brass trim.

3.4 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valve, one piece.
3. Bronze ball valve with bronze trim, one piece.
4. Brass ball valves, two-piece with full port and brass trim.
5. Bronze ball valves, two-piece with full port and bronze or brass trim.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Brass ball valve, one piece. Provide with threaded or solder-joint ends.
2. Bronze ball valve, one piece with bronze trim. Provide with threaded or solder-joint ends.
3. Brass ball valves, two-piece with full port and brass trim. Provide with threaded solder or press connection-joint ends.
4. Bronze ball valves, two-piece with full port and bronze or brass trim. Provide with threaded solder or press-connection-joint ends.

END OF SECTION 220523.12

SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze swing check valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. WATTS.
2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Jenkins Valves; a Crane brand.
   c. NIBCO INC.
   d. WATTS.
   e. Zurn.
2. Description:
   a. Standard: MSS SP-80, Type 4.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: PTFE.

C. Bronze Swing Check Valves, Press Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. Watts.
2. Description:
   a. Standard: MSS SP-80 and MSS SP-139.
   b. CWP Rating: Minimum 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 584, bronze.
   e. Ends: Press.
   f. Press Ends Connection Rating: Minimum 200 psig
   g. Disc: Brass or bronze.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered or press-ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
3. For Copper Tubing, NPS 5 and Larger: Flanged.
4. For Steel Piping, NPS 2 and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded.
6. For Steel Piping, NPS 5 and Larger: Flanged.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze swing check valves nonmetallic disc, Class 125, with threaded end connections.

END OF SECTION 220523.14

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Pipe-positioning systems.
6. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

1.2 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7 .

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel .

B. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel .

2.3 TRAPEZE PIPE HANGERS

2.4 THERMAL HANGER-SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 MATERIALS

A. Aluminum: ASTM B 221.

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Install lateral bracing with pipe hangers and supports to prevent swaying.

E. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

G. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

3.6 PAINTING

A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
13. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
14. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
15. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
16. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
17. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
18. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
19. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
3. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
4. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
5. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
6. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Storm-water piping exposed to freezing conditions.
4. Roof drains and rainwater leaders.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

A. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA.
   b. Armacell LLC.
   c. K-Flex USA.

G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Owens Corning.
2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ .
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
   c. Mon-Eco Industries, Inc.
2. Verify adhesives have a VOC content of 80 g/L or less.
3. Verify adhesives and sealants comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Speedline Corporation.
   c. The Dow Chemical Company.
2. Adhesive: As recommended by Adhesive - PVC Jacket manufacturer and with a VOC content of 50 g/L or less.
3. Verify adhesives and sealants comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Foster Brand; H. B. Fuller Construction Products.
   b. Mon-Eco Industries, Inc.
   c. Owens Corning.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 58 to plus 176 deg F .
4. Color: White or gray.
5. Verify sealant has a VOC content of 420 g/L or less.
6. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
   c. Mon-Eco Industries, Inc.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. Verify sealant has a VOC content of 420 g/L or less.
6. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. Verify sealant has a VOC content of 420 g/L or less.
6. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. P.I.C. Plastics, Inc.
   c. Speedline Corporation.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White .
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. 3M Industrial Adhesives and Tapes Division.
   b. Ideal Tape Co., Inc., an American Biltrite Company.
   c. Knauf Insulation.
2. Width: 3 inches .
3. Thickness: 11.5 mils .
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the contract documents.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.3 PENETRATIONS

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
   a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1/2 inch thick.
   b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be the following:
   a. Flexible Elastomeric: 1/2 inch thick.
   b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. PVC : 20 mils thick.

D. Piping, Exposed:

1. PVC : 20 mils thick.

END OF SECTION 220719

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service fire-service mains .

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

F. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping.

2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.6 PROJECT CONDITIONS

1.7 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type L , water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

B. Hard Copper Tube: ASTM B 88, Type L , water tube, drawn temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

C. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

E. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Anvil International.
      2) Smith-Cooper International.

3) Victaulic Company.

F. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 150 and Class 200.

1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

G. PVC, AWWA Pipe: AWWA C900, Class 150 and Class 200, with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.
2. PVC Fabricated Fittings: AWWA C900, Class 150 and Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   a. Gaskets: AWWA C111, rubber.
5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.2 JOINING MATERIALS

A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.3 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. FEBCO; A WATTS Brand.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1013 .
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
   b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 3/4 to NPS 3 shall be soft copper tube, ASTM B 88, Type L ; wrought-copper, solder-joint fittings; and brazed joints.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.4 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.

2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

E. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

G. Install PE pipe according to ASTM D 2774 and ASTM F 645.

H. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

I. Bury piping with depth of cover over top at least 48 inches , with top at least 12 inches below level of maximum frost penetration.

J. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

K. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

L. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

M. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for hangers, supports, and anchor devices specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

D. Install hangers for copper tubing with maximum spacing and minimum rod diameters to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting and coupling.

F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 JOINT CONSTRUCTION

A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
4. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
5. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
6. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.7 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.

2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.
6. Pipe clamps and tie rods.
7. .

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
3. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

C. MSS Valves: Install as component of connected piping system.

D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.9 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

B. Water Meters: Install displacement-type water meters, NPS 2 and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.

C. Water Meters: Install compound-type water meters, NPS 3 and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.10 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.11 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig . Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.12 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.13 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
   a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.

b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. PEX tube and fittings.
3. Transition fittings.
4. Dielectric fittings.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

1.4 WARRANTY

A. Polypropylene Piping (PP-R) Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.

1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.
2. Warranty is to be in effect only upon submission by the Contractor to the manufacturer of valid pressure/leak documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B88, Type L .

B. Annealed-Temper Copper Tube: ASTM B88, Type L .

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Wrought Copper Unions: ASME B16.22.

G. Copper Tube, Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. NIBCO INC.
   c. Viega LLC.
2. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end.
3. Minimum 200-psig working-pressure rating at 250 deg F.

2.3 PEX TUBE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. REHAU.
2. Sioux Chief Manufacturing Company, Inc.
3. Uponor.
4. Viega LLC.
5. Zurn Industries, LLC.

B. Tube Material: PEX plastic according to ASTM F876 and ASTM F877.

C. Fittings: ASTM F1807, metal insert and copper crimp rings ASTM F1960, cold expansion fittings and reinforcing rings.

D. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F876; with plastic or corrosion-resistant-metal valve for each outlet.

2.4 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. WATTS.
   b. Wilkins.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F .
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. WATTS.
   b. Wilkins.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F .
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Grinnell G-Fire by Johnson Controls Company.
   b. Sioux Chief Manufacturing Company, Inc.

c. Victaulic Company.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F .
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller , shall be one of the following:

1. Soft copper tube, ASTM B88, Type L ; wrought-copper, solder-joint fittings; and brazed copper pressure-seal fittings; and pressure-sealed joints.

D. Aboveground domestic water piping, NPS 2 and smaller , shall be one of the following:

1. Hard copper tube, ASTM B88, Type L ; cast- or wrought-copper, solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B88, Type L ; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B88, Type L ; copper push-on-joint fittings; and push-on joints.
4. PEX tube, NPS 1 and smaller.
   a. Fittings for PEX tube:
      1) ASTM F1807, metal insert and copper crimp rings.
      2) ASTM F1960, cold expansion fittings and reinforcing rings.
      3) ASSE 1061, push-fit fittings.

E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 , shall be one of the following:

1. Hard copper tube, ASTM B88, Type L ; cast- or wrought-copper, solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B88, Type L ; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B88, Type L ; grooved-joint, copper-tube appurtenances; and grooved joints.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install valves according to the following:

1. Section 220523.12 "Ball Valves for Plumbing Piping."
2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
3. Section 220523.14 "Check Valves for Plumbing Piping."
4. Section 220523.15 "Gate Valves for Plumbing Piping."

D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

E. Install domestic water piping level and plumb.

F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Install piping to permit valve servicing.

K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install PEX tubing with loop at each change of direction of more than 90 degrees.

O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

P. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220519 "Meters and Gages for Plumbing Piping."

Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

R. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.

I. Joints for PEX Tubing, ASTM: Join according to ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.

J. Joints for PEX Tubing, ASSE: Join according to ASSE 1061 for push-fit fittings.

K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings .

3.6 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 : Use dielectric flanges .

3.7 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for copper tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install vinyl-coated hangers for PEX tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping within 12 inches of each fitting.

E. Support vertical runs of copper to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support vertical runs of PEX tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:
   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
   c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
   a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
   c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
   f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Repeat procedures if biological examination shows contamination.

e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers for domestic water piping.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer device.

B. Related Requirements:

1. Section 211100 "Facility Fire-Suppression Water-Service Piping" for fire water-service backflow prevention devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze Chrome plated.

B. Hose-Connection Vacuum Breakers :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. WATTS.
   b. Woodford Manufacturing Company.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated .

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. FEBCO; A WATTS Brand.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Body: Bronze cast silicon copper alloy or stainless steel for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.

8. Accessories:
   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
   c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, Backflow-Prevention Assemblies :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. FEBCO; A WATTS Brand.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Body: Bronze cast silicon copper alloy or stainless steel for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:
   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller; bronze cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded or solder for NPS 2 and smaller; flanged or solder for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. Memory-Stop Balancing Valves :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Crane; a Crane Co. brand.
   c. NIBCO INC.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass or stainless steel.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Leonard Valve Company.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F .
9. Valve Finish: Chrome plated .

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Titan Flow Control, Inc.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.

4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Drain: Pipe plug Factory-installed, hose-end drain valve.

2.9 HOSE BIBBS

A. Hose Bibbs :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Woodford Manufacturing Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle Operating key.
14. Operation for Finished Rooms: Wheel handle Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Nonfreeze Vacuum Breaker Wall Hydrants :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. WATTS.
   b. Woodford Manufacturing Company.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1019, Type A or Type B.
3. Type: Automatic draining with integral air-inlet valve.
4. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig.
6. Operation: Loose key .
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.

8. Inlet: NPS 1/2 or NPS 3/4.
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves :

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Sioux Chief Manufacturing Company, Inc.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows Piston Diaphragm.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Sioux Chief Manufacturing Company, Inc.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.

7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. MIFAB, Inc.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

C. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Y-Pattern Strainers: For water, install on supply side of each water pressure-reducing valve and pump.

F. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

G. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

H. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Wall hydrants.
7. Trap-seal primer device.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

D. Adjust each reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

END OF SECTION 221119

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonpressure-type transition couplings.
2. Pressure-type pipe couplings.
3. Expansion joints and deflection fittings.
4. Backwater valves.
5. Cleanouts.
6. Concrete.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fernco Inc.
   b. Mission Rubber Company, LLC; a division of MCP Industries.
   c. NDS Inc.

D. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fernco Inc.
   b. Logan Clay Pipe.
   c. Mission Rubber Company, LLC; a division of MCP Industries.

E. Nonpressure-Type, Rigid Couplings:

1. Description: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. ANACO-Husky.

2.3 BACKWATER VALVES

A. Cast-Iron Backwater Valves:

1. Description: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.
2. <Click here to find, evaluate, and insert list of manufacturers and products.>
3. Horizontal type; with swing check valve and hub-and-spigot ends.
4. Combination horizontal and manual gate-valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.
5. Terminal type; with bronze seat, swing check valve, and hub inlet.

B. PVC Backwater Valves:

1. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.
2. <Click here to find, evaluate, and insert list of manufacturers and products.>

2.4 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
3. Top-Loading Classification(s): Medium Duty Heavy Duty and Extra-Heavy Duty.
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.5 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350, and the following:

1. Cement: ASTM C 150/C 150M, Type II.
2. Fine Aggregate: ASTM C 33/C 33M, sand.
3. Coarse Aggregate: ASTM C 33/C 33M, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A 1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

E. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 36-inch minimum cover.
4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.

F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
4. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
5. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. Unshielded flexible or rigidcouplings for pipes of same or slightly different OD.

b. Unshielded, increaser/reducer-pattern, flexible or rigidcouplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.5 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping manholes or pits.

B. Install combination horizontal and manual gate-type valves in piping and in manholes.

C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
2. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
3. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads .

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
   a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
   b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

C. Connect to oil and sand interceptors specified in Section 221323 "Sanitary Waste Interceptors."

3.8 IDENTIFICATION

A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

END OF SECTION 221313

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. ABS pipe and fittings.
3. PVC pipe and fittings.
4. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water .

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings: ASTM A 74, Service class.

C. Gaskets: ASTM C 564, rubber.

D. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 ABS PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

C. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

D. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

E. Solvent Cement: ASTM D 2235.

2.5 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F 656.

F. Solvent Cement: ASTM D 2564.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Unshielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dallas Specialty & Mfg. Co.
      2) Fernco Inc.
      3) Mission Rubber Company, LLC; a division of MCP Industries.
   b. Standard: ASTM C 1173.
   c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. End Connections: Same size as and compatible with pipes to be joined.
   e. Sleeve Materials:
      1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
3. Shielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Cascade Waterworks Mfg. Co.
      2) Mission Rubber Company, LLC; a division of MCP Industries.
   b. Standard: ASTM C 1460.
   c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    a. Straight tees, elbows, and crosses may be used on vent lines.
3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

O. Install aboveground ABS piping according to ASTM D 2661.

P. Install aboveground PVC piping according to ASTM D 2665.

Q. Install underground ABS and PVC piping according to ASTM D 2321.

R. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping.
   a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
   a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary waste gravity-flow piping.
   a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Unshielded Shielded, nonpressure transition couplings.

3.5 VALVE INSTALLATION

A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.

B. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install hangers for ABS and PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

E. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support vertical runs of ABS and PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves in pit with pit cover flush with floor .
6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect waste piping as indicated.
   a. Provide shutoff valve if indicated and union for each connection.
   b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
3. Solid-wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
3. Solid-wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

E. Underground, soil and waste piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
2. Section 077200 "Roof Accessories" for preformed flashings.
3. Section 078413 "Penetration Firestopping" for through-penetration firestop assemblies.
4. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
5. Section 334200 "Stormwater Conveyance" for storm drainage piping and piping specialties outside the building.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves Where indicated on Drawings :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: Hub and spigot or hubless .
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed .
8. Extension: ASTM A74, Service Class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Horizontal, Plastic Backwater Valves Where indicated on Drawings :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. IPS Corporation.
   b. Sioux Chief Manufacturing Company, Inc.
   c. Zurn Industries, LLC.
2. Size: Same as connected piping.
3. Body: ABS PVC.
4. Cover: Same material as body with threaded access to check valve.
5. Check Valve: Removable swing check.
6. End Connections: Socket type.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk , brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required .
7. Outlet Connection: Inside calk Spigot Threaded.
8. Closure: Brass plug with tapered threads .
9. Adjustable Housing Material: Cast iron with threads setscrews or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy .
11. Frame and Cover Shape: Round .
12. Top-Loading Classification: Heavy Medium Duty.
13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
   a. Brass .
   b. Countersunk or raised head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
7. Wall Access, Frame and Cover: Round , nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps :

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings :

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Floor-Drain, Inline Trap Seal :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. RectorSeal Plumbing; A CSW Industrials Company.
2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
3. Material: Polymer.
4. Standard: Tested and certified in accordance with ASSE 1072.
5. Listing: ICC-ES or IAPMO listed.
6. Size: Same as floor drain outlet or strainer throat.

D. Air-Gap Fittings :

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device :

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings :

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Assemble open drain fittings and install with top of hub 1 inch above floor.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

J. Install vent caps on each vent pipe passing through roof.

K. Install wood-blocking reinforcement for wall-mounting-type specialties.

L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221319.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor drains.
2. Floor sinks.

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

F. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Sioux Chief Manufacturing Company, Inc.
c. Zurn Industries, LLC.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron .
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Not required .
8. Outlet: Bottom .
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel .
11. Sediment Bucket: Not required .
12. Top or Strainer Material: Nickel bronze .
13. Top of Body and Strainer Finish: Nickel bronze .
14. Top Shape: Round .

B. Plastic Floor Drains :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Sioux Chief Manufacturing Company, Inc.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.6.3.
3. Material: ABS or PVC .
4. Seepage Flange: Not required .
5. Clamping Device: Not required .
6. Outlet: Bottom .
7. Sediment Bucket: Not required .
8. Top or Strainer Material: Bronze .
9. Top of Body and Strainer Finish: Nickel bronze .
10. Top Shape: Round .

2.3 FLOOR SINKS

A. Plastic Floor Sinks :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. IPS Corporation.
   b. Oatey.
   c. Sioux Chief Manufacturing Company, Inc.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: PVC.
5. Outlet: Bottom, PVC primer and solvent cement, connection.
6. Sediment Bucket: Not required .

7. Internal Strainer: Not required .
8. Internal Strainer Material: PVC .
9. Top Grate Material: PVC .
10. Top Shape: Square .
11. Top Loading Classification: No traffic .
12. Funnel: Not required . .
13. .

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
   a. Maintain integrity of waterproof membranes where penetrated.
5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

D. Install piping adjacent to equipment to allow service and maintenance.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Residential, electric, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 Retain "Seismic Qualification Data" Paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." See ASCE/SEI 7 for certification requirements for equipment and components.

1.5 CLOSEOUT SUBMITTALS

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Periods: From date of Substantial Completion.
   a. Residential, Electric, Storage, Domestic-Water Heaters:
      1) Storage Tank: Six years.
      2) Controls and Other Components: 6 years.
   b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 RESIDENTIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Residential, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. A. O. Smith Corporation.
   b. Bradford White Corporation.
   c. Rheem Manufacturing Company.
2. Standard: UL 174.
3. Storage-Tank Construction: Steel.
   a. Tappings: ASME B1.20.1 pipe thread.
   b. Pressure Rating: 150 psig.
   c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed, Storage-Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
   c. Drain Valve: Corrosion-resistant metal with hose-end connection.
   d. Insulation: Comply with ASHRAE/IES 90.1 .
   e. Jacket: Steel, cylindrical, with enameled finish or high-impact composite material.
   f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
   g. Heating Elements: Electric, screw-in immersion type.
   h. Temperature Control: Adjustable thermostat.
   i. Safety Control: High-temperature-limit cutoff device or system.
   j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. A. O. Smith Corporation.
   b. AMTROL, Inc.
   c. Taco Comfort Solutions.
2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:
   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
   a. Working-Pressure Rating: 150 psig .
   b. Capacity Acceptable: 2 gal. minimum.
   c. Air Precharge Pressure: 50 psi .

B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.

C. Heat-Trap Fittings: ASHRAE/IES 90.1 .

D. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Residential, Electric, Domestic-Water Heater Mounting: Install residential, electric, domestic-water heaters on floor .

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

C. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill electric, domestic-water heaters with water.

J. Charge domestic-water expansion tanks with air to required system pressure.

K. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

L. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.2 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

END OF SECTION 223300

SECTION 224100 - RESIDENTIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bathtubs.
2. Bathtub faucets.
3. Lavatories.
4. Lavatory faucets.
5. Showers.
6. Shower faucets.
7. Kitchen sinks.
8. Laundry trays
9. Sink faucets.
10. Disposers.
11. Water closets.
12. Toilet seats.
13. Supply fittings.
14. Waste fittings.
15. Grout.

B. Related Requirements:

1. Section 224213.13 "Commercial Water Closets."
2. Section 224213.16 "Commercial Urinals."
3. Section 224216.13 "Commercial Lavatories."
4. Section 224216.16 "Commercial Sinks."
5. Section 224223 "Commercial Showers."
6. Section 224300 "Healthcare Plumbing Fixtures."
7. Section 224500 "Emergency Plumbing Fixtures."
8. Section 224600 "Security Plumbing Fixtures."
9. Section 224713 "Drinking Fountains."
10. Section 224716 "Pressure Water Coolers."
11. Section 224723 "Remote Water Coolers."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

1.5 WARRANTY

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

2.2 BATHTUBS

A. Bathtubs with Shower - PMMA :

1. PMMA Bathtubs:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Kohler Co.
      3) Swan Corporation (The).
2. Fixture:
   a. Standard:
      1) ASME A112.19.1/CSA B45.2 for enameled bathtubs.
      2) IAPMO Z124/CSA B45.5 for PMMA plastic bathtubs.
   b. Bathing Surface: Slip resistant.
   c. Color: White .
   d. Drain: NPS 1-1/2; chrome-plated brass, pop-up waste and overflow.
3. Faucet: .
4. Supply Fittings: Included in faucet.
5. Tub Filler: Chrome-plated-brass diverter spout.
6. Waste Fittings:
   a. Standard: ASME A112.18.2/CSA B125.2.
   b. Drain: Stainless steel or chrome-plated brass, removable strainer.
   c. Overflow: Chrome-plated-brass escutcheon with toggle drain-plug device.
   d. Drain Piping:
      1) Schedule 40 PVC, NPS 1-1/2 P-trap, and waste.

2.3 BATHTUB FAUCETS

A. NSF Standard: Comply with NSF61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Bathtub Faucets - Single Handle, Pressure Balance :

1. Pressure-Balance Faucets:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1) American Standard.
   2) Kohler Co.
   3) Moen Incorporated.

2. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016/ASME A112.1016/CSA B125.16.
3. Faucet:
   a. Body Material: Solid brass.
   b. Finish: Polished chrome plate.
   c. Maximum Flow Rate: 2.5 gpm unless otherwise indicated.
   d. Mounting: Concealed .
   e. Operation: Single handle, push-pull or twist-or-rotate control, with hot- and cold-water indicators.
   f. Antiscald Device: Integral with mixing valve .
   g. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
   h. Diverter: In-tub filler spout.
   i. Supply Connections: NPS 1/2.
4. Shower Head:
   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Type: Ball joint with arm and flange Without ball joint, but with arm and flange Hand shower. Include wall-mounting device .
   c. Backflow-Prevention Device: ASSE 1014.
   d. Shower Head Material: Metallic with chrome-plated finish.
   e. Spray Pattern: Adjustable .
   f. Integral Volume Control: 2.0 GPM maximum .
   g. Shower-Arm, Flow-Control Fitting: Not required .
   h. Temperature Indicator: Not required.
5. Bathtub Filler Spout: Chrome-plated brass.

2.4 LAVATORIES

A. Lavatories - Vitreous China , Counter Top Mounted :

1. Vitreous-China Lavatories:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) American Standard.
      2) Kohler Co.
      3) Peerless Pottery Sales, Inc.
2. Fixture:
   a. Standard:
      1) IAPMO Z124.3/ANSI Z124.3 for PMMA lavatories.
      2) ASME A112.19.3/CSA B45.4 for stainless steel lavatories.
      3) ASME A112.19.2/CSA B45.1 for vitreous-china lavatories.
   b. Type: Self-rimming.
   c. Oval Nominal Size: 20 by 17 inches .
   d. Faucet-Hole Punching: Three holes, 2-inch centers .

e. Faucet-Hole Location: Rim.
f. Color: Selected by architect .

3. Faucet: .
4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article.

2.5 LAVATORY FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets Valve - Two Handle, Mixing :

1. General-Duty, Solid-Brass Faucets:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Delta Faucet Company.
      3) Kohler Co.
      4) Peerless.
2. General-Duty, Copper- or Brass-Underbody Faucets:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Eljer, Inc.
      3) Peerless.
3. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
4. Standard: ASME A112.18.1/CSA B125.1.
5. Body Material: General duty, solid brass .
6. Finish: Polished chrome plate .
7. Maximum Flow Rate: 1.5 GPM 2.2 gpm .
8. Centers: 4 inches .
9. Mounting: Deck, exposed .
10. Valve Handle(s): Lever .
11. Inlet(s): NPS 3/8 tubing, with NPS 1/2 male adaptor NPS 1/2 male shank .
12. Spout: Rigid Rigid, gooseneck .
13. Spout Outlet: Aerator .
14. Drain: Pop up .

2.6 SHOWERS

A. Showers - Standard PMMA with Base and Faucet :

1. PMMA Showers:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1) Aqua Bath Company, Inc.
   2) Kohler Co.
   3) Swan.

2. Standard: IAPMO Z124.1.2/ANSI Z124.1.2.
3. Surround:
   a. One piece.
   b. Surround: One piece.
4. Bathing Surface: Slip resistant.
5. Color: White .
6. Faucet: .

B. Showers - Accessible, PMMA with Seat, Grab Bar, Base, and Faucet :

1. PMMA Showers:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Aqua Bath Company, Inc.
      2) Clarion Bathware.
      3) Sterling.
      4) swan.
2. Standards: IAPMO Z124.1.2/ANSI Z124.1.2 and ICC/ANSI A117.1 for roll-in shower compartments.
3. Bathing Surface: Slip resistant.
4. Color: White .
5. Accessibility Options: Grab bar and bench.
6. Faucet: Shower .
7. Drain: Grid, NPS 2.

2.7 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Shower Faucets :

1. Single-Handle, Pressure-Balance Faucets:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Kohler Co.
      3) Peerless.
2. Fixture:
   a. Description: Include hot- and cold-water indicators, check stops, and handheld head complying with ASSE 1014 with arm, flange, hose, and bracket. Coordinate faucet inlets with supplies.

b. Standard: ASME A112.18.1/CSA B125.1 and ASSE 1016.
c. Body Material: Solid brass with nonmetallic trim.
d. Finish: Polished chrome plate .
e. Maximum Flow Rate: 2.5 gpm unless otherwise indicated.
f. Mounting: Exposed .
g. Backflow-Prevention Device for Handheld Shower: Required .
h. Antiscald Device: Integral with mixing valve Separate unit .
i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

3. Supply Connections: NPS 1/2 .
4. Shower Head:
   a. Type: Ball joint and head integral with mounting flange Handheld, slide-bar mounted .
   b. Shower Head Material: Nonmetallic with chrome-plated finish.
   c. Spray Pattern: Fixed .
   d. Integral Volume Control: 2.0 GPM .
   e. Shower-Arm, Flow-Control Fitting: Not required .

2.8 KITCHEN SINKS

A. Kitchen Sinks - Counter Mounted :

1. Stainless Steel Kitchen Sinks:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Elkay.
      3) Sterling.
2. Fixture:
   a. IAMPO Z124.3/ANSI Z124.3 for PMMA kitchen sinks.
   b. IAMPO Z124.3/ANSI Z124.3 for solid-surface kitchen sinks.
   c. ASME A112.19.3/CSA B45.4 for stainless steel kitchen sinks.
   d. Metal Thickness: 0.050 inch .
   e. Left Bowl:
      1) Dimensions: .
      2) Drain: 3-1/2-inch [**crumb cup**] [**grid**] [**grid with offset waste**] [**outlet for disposer**].
         a) Location: [**Centered in bowl**] [**Near back of bowl**] <**Insert location**>.
3. Faucet: .
4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article, except include continuous waste for multibowl sinks.
   a. Disposer: Insinkerator badger 5 .

2.9 LAUNDRY TRAYS

2.10 SINK FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Sink Faucets :

1. General-Duty, Solid-Brass Faucets:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Peerless.

2.11 DISPOSERS

A. Disposers Continuous-Feed Household, Food Waste:

1. Continuous-Feed Disposers:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) InSinkErator; Emerson Electric Co., Commercial and Residential Solutions.
      2) KitchenAid; a division of Whirlpool Corporation.
      3) Maytag; a division of Whirlpool Corporation.
2. Standards: ASSE 1008 and UL 430, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. General: Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless steel grinder or shredder; NPS 1-1/2 outlet; quick-mounting, stainless steel sink flange; antisplash guard; and combination cover/stopper.
4. Motor: 115 V ac, 1725 rpm, 1/2 hp with overload protection.

2.12 WATER CLOSETS

A. Water Closets : Floor mounted, floor outlet, close coupled (gravity tank), vitreous china, 1.28 gal./flush .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard.
   b. Eljer, Inc.
   c. Gerber Plumbing Fixtures LLC.
   d. Kohler Co.
   e. TOTO USA, INC.
2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1, ASME A112.19.5/CSA B45.15, and ASSE 1037/ASME A112.1060/CSA B125.16.
b. Bowl Type: Siphon jet .
c. Height: Standard Handicapped/elderly.
d. Rim Contour: Elongated .
e. Water Consumption: Water saving .
f. Color: White .

3. Toilet Seat: .
4. Supply Fittings:
   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
   c. Stop: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.
      1) Operation: Wheel handle .
   d. Riser:
      1) Size: NPS 3/8 .
      2) Material: Chrome-plated, soft-copper flexible tube riser.

2.13 TOILET SEATS

A. Toilet Seats :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Bemis Manufacturing Company.
   c. Kohler Co.
2. Standard: IAPMO Z124.5/ANSI Z124.5.
3. Material: Plastic.
4. Type: Residential .
5. Shape: Elongated rim (Closed front).
6. Configuration: Closed front with cover.
7. Size: Elongated .
8. Hinge Type: Self-sustaining .
9. Hinge Material: Plastic.
10. Seat Cover: Required .
11. Color: White .

2.14 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Lavatory Kitchen Sink Supply Fittings:

1. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
2. Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.
   a. Operation: Wheel handle .
3. Risers:
   a. Size:
      1) NPS 3/8 for lavatories.
      2) NPS 3/8 for kitchen sinks .
   b. Material: ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless-steel flexible hose riser.

2.15 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Pop-up type with NPS 1-1/4 straight tailpiece as part of faucet for standard lavatories.

C. Trap:

1. Size:
   a. NPS 1-1/4 for lavatories.
   b. NPS 1-1/2 for kitchen sinks .
2. Material:
   a. Chrome-plated, ; and chrome-plated-brass or -steel wall flange.
   b. ASTM F409 PVC two-piece trap and waste to wall and wall flange.

2.16 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000 psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumbing fixtures level and plumb in accordance with roughing-in drawings.

B. Install floor-mounted water closets on closet flange attachments to drainage piping.

C. Install counter-mounting fixtures in and attached to casework.

D. Install pedestal lavatories on pedestals and secured to wood blocking in wall.

E. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Use ball or gate valves if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

F. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

G. Install toilet seats on water closets.

H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

I. Install shower flow-control fittings with specified maximum flow rates in shower arms.

J. Install traps on fixture outlets.

1. Omit trap on fixtures with integral traps.
2. Omit trap on indirect wastes unless otherwise indicated.

K. Install disposer in outlet of each sink indicated to have a disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

L. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.

M. Set bathtubs and shower receptors in leveling bed of cement grout.

N. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories . Comply with requirements in Section 220719 "Plumbing Piping Insulation."

O. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

P. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories . Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 ADJUSTING

A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.4 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.

B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224100

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor-mounted, bottom-outlet water closets.
2. Flushometer valves.
3. Toilet seats.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential water closets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. All water closets shall be water sense certified.
2. Comply with ASME A112.19.2/CSA B45.1 for water closets.
3. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
4. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
5. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
6. Comply with ASME A112.6.1M for water-closet supports.
7. Comply with ICC A117.1 for ADA-compliant water closets.
8. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous china water closets to sanitary drainage systems.
9. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

2.2 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets - Floor Mounted, Bottom Outlet, Top Spud: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Kohler Co.
c. TOTO USA, INC.
d. Zurn Industries, LLC.

2. Bowl:
a. Material: Vitreous china.
b. Type: Siphon jet.
c. Style: Flushometer valve.
d. Height: Standard ADA compliant.
e. Rim Contour: Elongated.
f. Water Consumption: 1.28 gal. per flush.
g. Spud Size and Location: NPS 1-1/2; top.
h. Color: White .

3. Flushometer Valve: .
4. Toilet Seat: .

B. Water Closets - Floor Mounted, Bottom Outlet, Close-Coupled Flushometer Tank: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. American Standard.
b. Kohler Co.
c. Zurn Industries, LLC.

2. Bowl:
a. Material: Vitreous china.
b. Type: Siphon jet.
c. Style: Flushometer tank, gravity .
d. Height: Standard ADA compliant.
e. Rim Contour: Elongated.
f. Water Consumption: 1.28 gal. per flush.
g. Color: White .

3. Toilet Seat: .

2.3 FLUSHOMETER VALVES

A. Flushometer Valves - Diaphragm, Lever Handle: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Sloan Valve Company.
b. Zurn Industries, LLC.

2. Minimum Pressure Rating: 125 psig.
3. Features: Include integral check stop and backflow-prevention device.
4. Material: Brass body with corrosion-resistant components.
5. Style: Exposed.
6. Flushometer-Valve Finish: Chrome-plated.
7. Handle Finish: Chrome-plated .
8. Consumption: 1.28 gal. per flush.

9. Minimum Inlet: NPS 1.
10. Minimum Outlet: NPS 1-1/4.

B. Flushometer Valves - Piston, Lever Handle: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Kohler Co.
   c. TOTO USA, INC.
2. Minimum Pressure Rating: 125 psig.
3. Features: Include integral check stop and backflow-prevention device.
4. Material: Brass body with corrosion-resistant components.
5. Style: Exposed.
6. Flushometer-Valve Finish: Chrome-plated.
7. Handle Finish: Chrome-plated .
8. Consumption: 1.28 gal. per flush.
9. Minimum Inlet: NPS 1.
10. Minimum Outlet: NPS 1-1/4.

2.4 TOILET SEATS

A. Toilet Seats: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Church Seats; Bemis Manufacturing Company.
   c. Kohler Co.
   d. TOTO USA, INC.
   e. Zurn Industries, LLC.
2. Material: Plastic.
3. Type: Commercial (Heavy duty).
4. Shape: Elongated rim, open front .
5. Hinge: Check .
6. Hinge Material: Noncorroding metal.
7. Seat Cover: Not required.
8. Color: White .
9. Surface Treatment: Not required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
5. Measure support height installation from finished floor, not structural floor.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations easily reachable for people with disabilities.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vitreous-china, counter-mounted lavatories.
2. Vitreous-china, wall-mounted lavatories.
3. Manually operated lavatory faucets.
4. Supply fittings.
5. Waste fittings.
6. Lavatory supports.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential lavatories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

A. Lavatory - Self-Rimming, Vitreous China, Counter Mounted :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Kohler Co.
   c. TOTO USA, INC.
2. Fixture:
   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: Self-rimming for above-counter mounting.
   c. Nominal Size:
      1) Oval, 20 by 17 inches .

2) Round, 19 inches .
d. Faucet-Hole Punching: One hole Three holes, 2-inch centers .
e. Faucet-Hole Location: Top.
f. Color: White .
g. Mounting Material: Sealant.
3. Faucet: .

B. Lavatory - Vitreous China, Undercounter Mounted :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. American Standard.
b. Kohler Co.
c. TOTO USA, INC.
2. Fixture:
a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For undercounter mounting.
c. Nominal Size: Oval, 19 by 16 inches 22 by 14 inches .
d. Faucet-Hole Punching: No holes.
e. Faucet-Hole Location: On countertop.
f. Color: White .
g. Mounting Material: Sealant and undercounter mounting kit.
3. Faucet: .

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory - Vitreous China, Wall Mounted, with Back :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. American Standard.
b. Gerber Plumbing Fixtures LLC.
c. Kohler Co.
2. Fixture:
a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Nominal Size: Rectangular, 18 by 16 inches .
d. Faucet-Hole Punching: One hole Three holes, 2-inch centers .
e. Faucet-Hole Location: Top.
f. Color: White .
g. Mounting Material: Chair carrier.
3. Faucet: .
4. Support: Type II, concealed-arm lavatory carrier . Include rectangular, steel uprights.
5. Lavatory Mounting Height: Standard Handicapped/elderly in accordance with ICC A117.1.

B. Lavatory - Ledge Back, Vitreous China, Wall Mounted :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Gerber Plumbing Fixtures LLC.
   c. Kohler Co.
2. Fixture:
   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: For wall hanging.
   c. Nominal Size: Rectangular, 19 by 17 inches 20 by 18 inches .
   d. Faucet-Hole Punching: One hole Three holes, 2-inch centers .
   e. Faucet-Hole Location: Top.
   f. Color: White .
   g. Mounting Material: Chair carrier.
3. Faucet: .
4. Support: Type II, concealed-arm lavatory carrier . Include rectangular, steel uprights .
5. Lavatory Mounting Height: Standard Handicapped/elderly in accordance with ICC A117.1.

2.3 MANUALLY OPERATED LAVATORY FAUCETS

A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Lavatory Faucets - Manual Type: Single-control mixing , commercial , .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Chicago Faucets; Geberit Company.
   c. Kohler Co.
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: Centerset Single hole .
5. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
6. Finish: Polished chrome plate .
7. Maximum Flow Rate: 0.5 gpm .
8. Maximum Flow: 0.25 gal. per metering cycle.
9. Mounting Type: Deck, exposed .
10. Valve Handle(s): Single lever Wrist blade, 4 inches .
11. Spout: Rigid type.
12. Spout Outlet: Aerator .

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key .

F. Risers:

1. NPS 3/8 .
2. ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4 NPS 1-1/4.
2. Material:
   a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall ; and chrome-plated, brass or steel wall flange.
   b. Stainless steel, two-piece trap and swivel elbow with 0.012-inch- thick stainless steel tube to wall; and stainless steel wall flange.

2.6 LAVATORY SUPPORTS

A. Lavatory Carrier:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lavatories level and plumb in accordance with roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.2 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
   a. Constant-volume air systems.
2. Testing, adjusting, and balancing of fuel oil systems for HVAC.
3. Testing, adjusting, and balancing of equipment.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

G. UFAD: Underfloor air distribution.

1.3 ACTION SUBMITTALS

1.4 INFORMATIONAL SUBMITTALS

A. Certified TAB reports.

B. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. TAB Specialists Qualifications, Certified by NEBB [**or**] TABB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.6 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.

F. Examine equipment performance data, including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.

L. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
   a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
   b. Duct systems are complete with terminals installed.
   c. Volume, smoke, and fire dampers are open and functional.
   d. Clean filters are installed.
   e. Fans are operating, free of vibration, and rotating in correct direction.
   f. Variable-frequency controllers' startup is complete and safeties are verified.
   g. Automatic temperature-control systems are operational.
   h. Ceilings are installed.
   i. Windows and doors are installed.
   j. Suitable access to balancing devices and equipment is provided.
2. Hydronics:
   a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
   b. Piping is complete with terminals installed.
   c. Water treatment is complete.
   d. Systems are flushed, filled, and air purged.
   e. Strainers are pulled and cleaned.
   f. Control valves are functioning in accordance with the sequence of operation.
   g. Shutoff and balance valves have been verified to be 100 percent open.
   h. Pumps are started and proper rotation is verified.
   i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   j. Variable-frequency controllers' startup is complete and safeties are verified.
   k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
4. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

1. Pumps.
2. Fans and ventilators.
3. Terminal units.
4. Furnaces.
5. Air-handling units.
6. Packaged air conditioners.
7. Self-contained air conditioners.
8. Split-system air conditioners.
9. Variable-refrigerant-flow systems.
10. Heat pumps.
11. Unit ventilators.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' Record drawings duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
   a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
   b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
   c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
2. Measure fan static pressures as follows:
   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report artificial loading of filters at the time static pressures are measured.
3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent . If design value is less than 100 cfm, within 10 cfm.
2. Air Outlets and Inlets: Plus or minus 10 percent . If design value is less than 100 cfm, within 10 cfm.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.8 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

3.9 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Field test reports prepared by system and equipment installers.
2. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms, including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Heating coil, dry-bulb conditions.
    e. Other system operating conditions that affect performance.
16. Test conditions for pump performance forms, including the following:
    a. Other system operating conditions that affect performance.

D. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and size.
    e. Arrangement and class.
    f. Sheave make, size in inches, and bore.
2. Motor Data:
    a. Motor make, and frame type and size.
    b. Horsepower and speed.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave and amount of adjustments in inches.
    g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan speed.

d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

E. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
   a. System fan and air-handling-unit number.
   b. Location and zone.
   c. Traverse air temperature in deg F.
   d. Duct static pressure in inches wg.
   e. Duct size in inches.
   f. Duct area in sq. ft..
   g. Indicated airflow rate in cfm.
   h. Indicated velocity in fpm.
   i. Actual airflow rate in cfm.
   j. Actual average velocity in fpm.
   k. Barometric pressure in psig.

F. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return.
4. Indoor, exposed return.
5. Indoor, concealed exhaust within 4' of the building exterior.

B. Related Sections:

1. Section 230716 "HVAC Equipment Insulation."
2. Section 230719 "HVAC Piping Insulation."
3. Section 233113 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type III with factory-applied FSK jacket . Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Owens Corning.

G. High-Temperature, Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1000 deg F. Comply with ASTM C553, Type V.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Owens Corning.

H. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ . Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Owens Corning.

I. High-Temperature, Glass-Fiber Board: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III, unfaced.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.

2.3 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. 3M Industrial Adhesives and Tapes Division.
   b. Ideal Tape Co., Inc., an American Biltrite Company.
   c. Knauf Insulation.
2. Width: 3 inches .
3. Thickness: 11.5 mils .
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. 3M Industrial Adhesives and Tapes Division.
   b. Ideal Tape Co., Inc., an American Biltrite Company.
   c. Knauf Insulation.
2. Width: 3 inches .
3. Thickness: 6.5 mils .
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.4 SECUREMENTS

A. Aluminum Bands: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.

b. RPR Products, Inc.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.
      2) Gemco.
      3) Midwest Fasteners, Inc.
   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel , fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Gemco.
      2) Midwest Fasteners, Inc.
   b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
   c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.
      2) Gemco.
      3) Midwest Fasteners, Inc.
   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel , fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.
      2) Gemco.
      3) Midwest Fasteners, Inc.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Gemco.
      2) Midwest Fasteners, Inc.

2.5 CORNER ANGLES

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

3.4 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

B. Comply with manufacturer's written installation instructions.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch

o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not overcompress insulation during installation.

e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply, return, and outdoor air intake.
2. Indoor, exposed supply, return, and outdoor air intake.
3. Indoor, concealed exhaust 4' from penetration of building exterior.

3.6 INDOOR DUCT INSIDE THE BUILDING ENVELOPE SCHEDULE

A. Concealed, Supply-Air Duct liner: Glass-fiber board , 1/2 inch thick and 3 lb/cu. ft. nominal density.

B. Concealed, Supply-Air Duct wrap: Glass-fiber blanket duct wrap, 1 inch thick and [0.75 lb/cu. ft. nominal density.

C. Concealed, Return-Air Duct liner: Glass-fiber board , 1/2 inch thick and 3 lb/cu. ft. nominal density.

D. Concealed, Outdoor-Air Duct wrap: Glass-fiber blanket , 3 inches thick and 0.75 lb/cu. ft. nominal density.

E. Concealed, Exhaust-Air Duct wrap: Glass-fiber blanket , 3 inches thick and 0.75 lb/cu. ft. nominal density.

F. Exposed, Supply-Air Duct liner: Glass-fiber board , 1 inch thick and 3 lb/cu. ft. nominal density.

3.7 ABOVEGROUND, DUCT IN UNCONDITIONED SPACE INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Concealed, Supply-Air Duct wrap: Glass-fiber blanket , 2 inches thick and 0.75 lb/cu. ft. nominal density.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulation for HVAC piping systems.

B. Related Requirements:

1. Section 230713 "Duct Insulation" for duct insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials, Type II, for sheet materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA.
   b. Armacell LLC.
   c. K-Flex USA.

E. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Owens Corning.
   c. ROCKWOOL Technical Insulation.
2. Preformed Pipe Insulation: Type II, Grade A .
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.

F. Polyolefin: Polyethylene thermal plastic insulation. Comply with or ASTM C1427, Type I, Grade 1, for tubular materials and with Type II, Grade 1, for sheet materials , self-seal.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armacell LLC.
   b. Nomaco.
   c. Sekisui Voltek, LLC.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

E. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.

F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

G. Install insulation with least number of joints practical.

H. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
   3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

I. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

J. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
4. For below-ambient services, apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

K. Cut insulation in a manner to avoid compressing insulation.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

N. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.7 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.8 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1/2" thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1" thick.

3.10 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1" thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation is the following:
   a. Flexible Elastomeric: 1" thick.

END OF SECTION 230719

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Manual gas shutoff valves.
5. Pressure regulators.
6. Dielectric unions.

1.2 ACTION SUBMITTALS

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less .

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. FlashShield Products; Gastite, a division of Titeflex Corp.
   b. TracPipe CounterStrike; Omega Flex, Inc.
2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
3. Coating: PE with flame retardant.
   a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      1) Flame-Spread Index: 25 or less.
      2) Smoke-Developed Index: 50 or less.
4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
5. Striker Plates: Steel, designed to protect tubing from penetrations.
6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 5 psig.

C. PE Pipe: ASTM D 2513, SDR 11.

1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
   b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
   c. Aboveground Portion: PE transition fitting.
   d. Outlet shall be threaded or suitable for welded connection.
   e. Tracer wire connection.
   f. Ultraviolet shield.
   g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
4. Transition Service-Line Risers: Factory fabricated and leak tested.
   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.

b. Outlet shall be threaded or suitable for welded connection.
c. Bridging sleeve over mechanical coupling.
d. Factory-connected anode.
e. Tracer wire connection.
f. Ultraviolet shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig .
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. BrassCraft Manufacturing Co.; a Masco company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. BrassCraft Manufacturing Co.; a Masco company.
   c. Perfection Corporation.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. A.Y. McDonald Mfg. Co.
   b. Lee Brass Company.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. American Meter Company.
   b. Invensys.
   c. Maxitrol Company.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 5 psig .

2.7 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jomar Valve.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Description:
   a. Standard: ASSE 1079.
   b. Pressure Rating: 125 psig minimum at 180 deg F .
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.8 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Install fittings for changes in direction and branch connections.

3.2 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Verify final equipment locations for roughing-in.

K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

P. Connect branch piping from top or side of horizontal piping.

Q. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.

R. Do not use natural-gas piping as grounding electrode.

S. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for steel piping , with maximum horizontal spacing and minimum rod diameter, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for corrugated stainless-steel tubing, with maximum horizontal spacing and minimum rod diameter, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of corrugated stainless-steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

A. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

A. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

B. Natural-gas piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be one of the following:

1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.10 INDOOR PIPING SCHEDULE

A. Aboveground, branch piping 1/2" and smaller shall be the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

2. Steel pipe with wrought-steel fittings and welded joints.

3.11 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.

B. Underground: PE valves.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves in branch piping for single appliance shall be one of the following:

1. Two-piece, -port, bronze ball valves with bronze trim.
2. Bronze plug valve.

END OF SECTION 231123

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Valves and specialties.
4. Refrigerants.

1.2 ACTION SUBMITTALS

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings, Brazed-Joint: ASME B16.50.

C. Copper-Tube, Pressure-Seal-Joint Fittings for Refrigerant Piping:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conex Banninger - USA.
   b. Parker Hannifin, Sporlan Division.
   c. RLS LLC.
2. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
3. Housing: Copper.
4. O-Rings: HNBR or compatible with specific refrigerant.
5. Tools: Manufacturer's approved special tools.
6. Minimum Rated Pressure: 700 psig.

2.3 VALVES AND SPECIALTIES

A. Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
4. Piston: Removable polytetrafluoroethylene seat.
5. Closing Spring: Stainless steel.
6. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
7. End Connections: Socket, union, threaded, or flanged.
8. Maximum Opening Pressure: 0.50 psig.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 275 deg F.

B. Service Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
2. Body: Forged brass with brass cap including key end to remove core.
3. Core: Removable ball-type check valve with stainless-steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig.

C. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
2. Body and Bonnet: Plated steel.
3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24 -V ac coil.
7. Working Pressure Rating: 400 psig.
8. Maximum Operating Temperature: 240 deg F.

D. Thermostatic Expansion Valves: Comply with AHRI 750.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies; Emerson Electric Co.
   c. Heldon Products; Henry Technologies.
2. Body, Bonnet, and Seal Cap: Forged brass or steel.
3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Packing and Gaskets: Non-asbestos.
5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
6. Superheat: Nonadjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 450 psig .

E. Permanent Filter Dryers: Comply with AHRI 730.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
2. Body and Cover: Painted-steel shell.
3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
4. Desiccant Media: Activated alumina .
5. Designed for reverse flow (for heat-pump applications).
6. End Connections: Socket.
7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: 2 psig .
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

2.4 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Arkema Inc.
   b. DuPont Fluorochemicals Div.
   c. Genetron Refrigerants; Honeywell International Inc.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Hot-Gas and Liquid Lines , and Suction Lines for Heat-Pump Applications:

1. Copper, Type ACR , annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
2. Copper, Type ACR , drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
3. Copper, , drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install valves in suction and discharge lines of compressor.

B. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

C. Except as otherwise indicated, install valves on inlet and outlet side of filter dryers.

D. Install a full-size, three-valve bypass around filter dryers.

E. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

F. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

G. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Compressor.

H. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

I. Install flexible connectors at compressors.

J. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to the authority having jurisdiction.

3.3 INSTALLATION OF PIPING, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic restraints in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

D. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.7 ADJUSTING

A. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

B. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

C. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.

3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

D. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 ACTION SUBMITTALS

1.4 INFORMATIONAL SUBMITTALS

1.5 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

D. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are actual inside sheet metal dimensions and include an allowance for duct liner insulation if applicable.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ductmate Industries, Inc.
   b. McGill AirFlow LLC.
   c. SEMCO, LLC; part of FlaktGroup.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-

support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch- minimum diameter for lengths 36 inches or less; 3/8-inch- minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corporation.
   b. Johns Manville; a Berkshire Hathaway company.
   c. Knauf Insulation.
2. Maximum Thermal Conductivity:
   a. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel ; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
8. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches .
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.

6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Ceiling radiation dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Corridor dampers.
10. Flange connectors.
11. Turning vanes.
12. Remote damper operators.
13. Duct-mounted access doors.
14. Flexible connectors.
15. Duct accessory hardware.

B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.
2. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
3. Section 284621.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.
4. Section 284621.13 "Conventional Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; CB-600 or comparable products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Cesco Products; a division of MESTEK, Inc.
3. Flex-Tek Group.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. Nailor Industries Inc.
7. NCA Manufacturing, Inc.
8. Pottorff.
9. Ruskin Company.
10. Safe Air - Dowco Products.
11. Vent Products Co., Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm .

D. Maximum System Pressure: 3-inch wg .

E. Frame: Hat-shaped, 0.06-inch- thick extruded aluminum , with welded corners or mechanically attached.

F. Blades: Multiple single-piece blades, off-center pivoted, maximum 6-inch width, 0.045-inch-thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Vinyl foam .

I. Blade Axles:

1. Material: Nonferrous metal Aluminum.
2. Diameter: 0.20 inch .

J. Tie Bars and Brackets: Aluminum .

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
   a. Sleeve Thickness: 20 gage minimum.
   b. Sleeve Length: 6 inches minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel Aluminum.
8. Screen Type: Bird .
9. 90-degree stops.

2.4 BAROMETRIC RELIEF DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; RCD CD or comparable products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Cesco Products; a division of MESTEK, Inc.
3. Greenheck Fan Corporation.
4. Lloyd Industries, Inc.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Pottorff.
8. Ruskin Company.
9. Safe Air - Dowco Products.
10. Vent Products Co., Inc.
11. .

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2400 fpm .

D. Maximum System Pressure: 3-inch wg .

E. Frame: Hat-shaped, 0.063-inch- thick extruded aluminum , with welded corners or mechanically attached.

F. Blades:

1. Multiple, 0.050-inch- thick aluminum sheet.
2. Maximum Width: 6 inches.
3. Action: Parallel.
4. Balance: Gravity.
5. Off-center pivoted End pivoted.

G. Blade Seals: Vinyl Neoprene.

H. Blade Axles: Stainless steel Nonmetallic.

I. Tie Bars and Brackets:

1. Material: Aluminum .
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Synthetic .

L. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.
3. .

2.5 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; MD-115 EB RD ED DW or comparable products by one of the following:
   a. Aire Technologies.
   b. American Warming and Ventilating; a Mestek Architectural Group company.
   c. Flexmaster U.S.A., Inc.
   d. Flex-Tek Group.
   e. McGill AirFlow LLC.
   f. Nailor Industries Inc.
   g. Pottorff.
   h. Ruskin Company.
   i. Safe Air - Dowco Products.
   j. Trox USA Inc.
   k. Vent Products Co., Inc.
2. Standard leakage rating , with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
   a. Frame: Hat-shaped, 0.0375-inch- thick, galvanized sheet steel .
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized -steel, 0.064 inch thick.
6. Blade Axles: Galvanized steel Stainless steel .
7. Bearings:
   a. Molded synthetic .
8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; MD-105 MD-106 SB or comparable products by one of the following:
   a. American Warming and Ventilating; a Mestek Architectural Group company.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.
   e. Ruskin Company.
   f. Safe Air - Dowco Products.
   g. Trox USA Inc.
   h. Vent Products Co., Inc.
   i. .
2. Standard leakage rating , with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.081-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Extruded-Aluminum Blades: 0.081-inch- thick extruded aluminum.
6. Blade Axles: Galvanized steel Stainless steel .
7. Bearings:
   a. Molded synthetic .
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; CD-110 CD-111 CD-160 CD-161 or comparable products by one of the following:
   a. American Warming and Ventilating; a Mestek Architectural Group company.
   b. Elgen Manufacturing.
   c. Flex-Tek Group.
   d. McGill AirFlow LLC.
   e. Nailor Industries Inc.
   f. Pottorff.
   g. Ruskin Company.
   h. Safe Air - Dowco Products.
   i. Trox USA Inc.
   j. Vent Products Co., Inc.
   k. .
2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating , with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames:
   a. U shaped.
   b. 0.05-inch- thick, galvanized sheet steel .
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized , roll-formed steel, 0.062 inch thick.
7. Blade Axles: Galvanized steel Stainless steel .
8. Bearings:
   a. Molded synthetic .
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
9. Blade Seals: Vinyl Neoprene.
10. Jamb Seals: Cambered stainless steel aluminum.
11. Tie Bars and Brackets: Galvanized steel Aluminum.
12. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; CD-75 CD-76 CD-100 CD-101 CD-145 CD-146 CD-150 CD-151 or comparable products by one of the following:
   a. American Warming and Ventilating; a Mestek Architectural Group company.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.
   e. Ruskin Company.
   f. Safe Air - Dowco Products.
   g. Trox USA Inc.
   h. Vent Products Co., Inc.
   i. .
2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating , with linkage outside airstream.
4. Suitable for horizontal or vertical applications.
5. Frames: Hat U -shaped, 0.081-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Extruded-Aluminum Blades: 0.081-inch- thick extruded aluminum.
7. Blade Axles: Galvanized steel Stainless steel .
8. Bearings:
   a. Molded synthetic .
9. Blade Seals: PVC Vinyl .
10. Jamb Seals: Cambered stainless steel.
11. Tie Bars and Brackets: Galvanized steel Aluminum.
12. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

E. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.6 CONTROL DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; RI CD-75 CD-76 CD-100 CD-101 or comparable products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Arrow United Industries.
3. Cesco Products; a division of MESTEK, Inc.
4. Flex-Tek Group.
5. Greenheck Fan Corporation.
6. Lloyd Industries, Inc.
7. McGill AirFlow LLC.
8. Metal Form Manufacturing, Inc.
9. Nailor Industries Inc.
10. NCA Manufacturing, Inc.
11. Pottorff.
12. Ruskin Company.
13. Safe Air - Dowco Products.
14. Vent Products Co., Inc.
15. Young Regulator Company.
16. .

B. Frames:

1. Hat U shaped.
2. 0.0375-inch- thick, galvanized sheet steel .

C. Blades:

1. Multiple blade with maximum blade width of 6.25 inches .
2. Blade Edging: Closed-cell neoprene PVC.

D. Blade Axles: 1/2-inch- diameter; galvanized steel ; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

E. Bearings:

1. Molded synthetic .

2.7 FIRE DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; FD-SB FDD-SB FD-SC FDD-C FD-C FD-R or comparable products by one of the following:

1. Aire Technologies.
2. American Warming and Ventilating; a Mestek Architectural Group company.
3. Arrow United Industries.
4. Cesco Products; a division of MESTEK, Inc.
5. Greenheck Fan Corporation.
6. Nailor Industries Inc.
7. NCA Manufacturing, Inc.
8. Pottorff.
9. Prefco.
10. Ruskin Company.
11. Safe Air - Dowco Products.
12. Vent Products Co., Inc.
13. Ward Industries; a brand of Hart & Cooley, Inc.
14. .

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Curtain type with blades outside airstream ; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.05 thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.024-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.8 CEILING RADIATION DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; C-S/R-A C/FSR-1 C/FSR-2 C-SR-WT C-SR-WTS or comparable products by one of the following:

1. Aire Technologies.
2. American Warming and Ventilating; a Mestek Architectural Group company.
3. Cesco Products; a division of MESTEK, Inc.
4. Nailor Industries Inc.
5. Pottorff.
6. Prefco.
7. Ruskin Company.
8. Safe Air - Dowco Products.
9. Ward Industries; a brand of Hart & Cooley, Inc.
10. .

B. General Requirements:

1. Labeled according to UL 555C by an NRTL.
2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

D. Blades: Galvanized sheet steel with refractory insulation.

E. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

F. Fire Rating: 1 hours.

2.9 COMBINATION FIRE AND SMOKE DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; F/S-3V-I F/S-3V-II F/S-RD-I or comparable products by one of the following:

1. Aire Technologies.
2. American Warming and Ventilating; a Mestek Architectural Group company.
3. Cesco Products; a division of MESTEK, Inc.
4. Greenheck Fan Corporation.
5. Nailor Industries Inc.
6. Pottorff.
7. Ruskin Company.
8. Safe Air - Dowco Products.
9. .

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Heat-Responsive Device: Resettable , 165 deg F rated, fire-closure device.

F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

G. Smoke Detector: Integral, factory wired for single-point connection.

H. Blades: Roll-formed, horizontal, interlocking overlapping , 0.063-inch- thick, galvanized sheet steel.

I. Leakage: Class I .

J. Rated pressure and velocity to exceed design airflow conditions.

K. Mounting Sleeve: Factory-installed, 0.039-inch- thick, galvanized sheet steel; length to suit wall or floor application.

L. Master control panel for use in dynamic smoke-management systems.

M. Damper Motors: two-position action.

N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

O. Accessories:

1. Auxiliary switches for signaling or position indication.
2. Test and reset switches , damper mounted.

2.10 CORRIDOR DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; F/S-3V-CR-I F/S-3V-CR-II or comparable products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Cesco Products; a division of MESTEK, Inc.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin Company.
6. Safe Air - Dowco Products.
7. .

B. General Requirements: Label combination fire and smoke dampers according to UL 555 for 1-hour or 1-1/2-hour rating by an NRTL.

C. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

D. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

E. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange.

F. Blades: Roll-formed, horizontal, overlapping, 0.034-inch- thick, galvanized sheet steel.

G. Mounting Sleeve: Factory-installed, 0.039-inch- thick, galvanized sheet steel; length to suit wall or floor application.

H. Damper Motors: two-position action.

I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

2.11 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Hardcast, Inc.
4. Nexus PDQ.
5. Ward Industries; a brand of Hart & Cooley, Inc.
6. .

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.12 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aero-Dyne Sound Control Co.
2. CL WARD & Family Inc.
3. Ductmate Industries, Inc.
4. Duro Dyne Inc.
5. Elgen Manufacturing.
6. Hardcast, Inc.
7. METALAIRE, Inc.
8. SEMCO LLC.
9. Ward Industries; a brand of Hart & Cooley, Inc.
10. .

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall.

F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.13 DUCT-MOUNTED ACCESS DOORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; O-95-H O-95-C L-95 or comparable products by one of the following:

1. Aire Technologies.
2. American Warming and Ventilating; a Mestek Architectural Group company.
3. Cesco Products; a division of MESTEK, Inc.
4. CL WARD & Family Inc.
5. Ductmate Industries, Inc.
6. Elgen Manufacturing.
7. Flexmaster U.S.A., Inc.
8. Greenheck Fan Corporation.
9. McGill AirFlow LLC.
10. Nailor Industries Inc.
11. Pottorff.
12. Ventfabrics, Inc.
13. Ward Industries; a brand of Hart & Cooley, Inc.
14. .

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.

2.14 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Elgen Manufacturing.
5. Hardcast, Inc.

6. JP Lamborn Co.
7. Ventfabrics, Inc.
8. Ward Industries; a brand of Hart & Cooley, Inc.
9. .

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd..
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd..
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.15 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install fire and smoke dampers according to UL listing.

G. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch- diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.

2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

I. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

J. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

N. Connect flexible ducts to metal ducts with draw bands .

O. Install duct test holes where required for testing and balancing purposes.

P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulated flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

A. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1 R6 .

B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1 R6 .

2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action Nylon strap in sizes 3 through 18 inches, to suit duct size.

B. Non-Clamp Connectors: .

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

D. Connect flexible ducts to metal ducts with draw bands .

E. Install duct test holes where required for testing and balancing purposes.

F. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

G. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.

3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 233346

SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backward-inclined centrifugal fans, including airfoil and curved blade fans.
2. Square in-line centrifugal fans.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product data showing compliance with Energy Star.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. All fans shall be Energy Star rated.

2.2 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acme Engineering & Manufacturing Corp.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. Loren Cook Company.

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, direct-driven centrifugal fans, consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
2. Factory-installed and -wired disconnect switch.

C. Housings:

1. Housing Material: Aluminum .
2. Housing Coating: None .
3. Formed panels to make curved-scroll housings with shaped cutoff.
4. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
5. Spun inlet cone with flange.

D. Shafts:

1. Statically and dynamically balanced, and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

E. Bearings:

1. Prelubricated and Sealed Shaft Bearings:
   a. Self-aligning, pillow-block-type ball bearings.

F. Motor Enclosure: Open, dripproof .

G. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

2.3 FORWARD-CURVED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acme Engineering & Manufacturing Corp.
2. Central Blower Company.
3. New York Blower Company (The).

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt- driven centrifugal fans, consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

C. Housings:

1. Housing Material: Aluminum .
2. Housing Coating: None .
3. Formed panels to make curved-scroll housings with shaped cutoff.
4. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
5. Spun inlet cone with flange.
6. Outlet flange.

D. Wheels:

1. Wheel and Blade Material: Aluminum .
2. Wheel and Blade Coating: None .
3. Cast-iron or cast-steel hub riveted to backplate and fastened to shaft with setscrews.
4. Forward-Curved Wheels:
   a. Black-enameled or galvanized-steel construction with inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow.
   b. Mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with setscrews.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Bearings:

1. Prelubricated and Sealed Shaft Bearings:
   a. Self-aligning, pillow-block-type ball bearings.

G. Motor Enclosure: Open, dripproof .

H. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

2.4 SQUARE IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acme Engineering & Manufacturing Corp.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. Greenheck Fan Corporation.
4. Loren Cook Company.

B. Description: Square in-line centrifugal fans.

C. Housing:

1. Housing Material: Reinforced steel .
2. Housing Coating: None .
3. Housing Construction: Side panels shall be easily removable for service. Include inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosures around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum airfoil blades welded to aluminum hub.

F. Motor Enclosure: Open, dripproof .

G. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.5 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

B. Where variable-frequency drives are indicated or scheduled, provide fan motor compatible with variable-frequency drive.

2.6 SOURCE QUALITY CONTROL

A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.

B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.

C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.

D. Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:

1. Support duct-mounted and other hanging centrifugal fans directly from the building structure, using suitable hanging systems as specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Curb Support, Field Built-Up: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," detail "Equipment Support Curb," number "SPF-9" (page 1409) and detail "Equipment Support Curb," number "SPF-9S" (page 1410). Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction.

F. Curb Support, Prefabricated: Rail-type wood support provided by fan manufacturer.

G. Unit Support: Install centrifugal fans level on structural curbs . Coordinate with duct connections. Secure units to structural support with anchor bolts.

H. Install units with clearances for service and maintenance.

I. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK AND PIPING CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

D. Install heat tracing on all drain piping subject to freezing temperature and as indicated on Drawings. Furnish and install heat tracing according to Section 230533 "Heat Tracing for HVAC Piping."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

D. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.6 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: will engage a qualified testing agency to perform tests and inspections.

B. Prepare test and inspection reports.

3.8 DEMONSTRATION

A. Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233416

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ceiling-mounted ventilators.

1.3 ACTION SUBMITTALS

A. Product Data:

PART 2 - PRODUCTS

2.1 CEILING-MOUNTED VENTILATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. PennBarry.

B. Housing: Steel, lined with acoustical insulation.

C. Fans shall be Energy Star Rated

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel removable for service.

E. Back-draft damper: Integral.

F. Grille: Plastic , louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.

G. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

H. Accessories:

1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 INSTALLATION OF HVAC POWER VENTILATORS

A. Install power ventilators level and plumb.

B. Install units with clearances for service and maintenance.

C. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that there is adequate maintenance and access space.
4. Verify that cleaning and adjusting are complete.
5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
6. Adjust belt tension.
7. Adjust damper linkages for proper damper operation.
8. Verify lubrication for bearings and other moving parts.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
10. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
11. Shut unit down and reconnect automatic temperature-control operators.
12. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

C. Replace fan and motor pulleys as required to achieve design airflow.

END OF SECTION 233423

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Louver face diffusers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.
3. Section 233713.43 "Security Registers and Grilles" for security registers and security grilles.
4. Section 233716 "Fabric Air-Diffusion Devices" for continuous tubular diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Nailor Industries Inc.
2. Price Industries.
3. Titus; brand of Johnson Controls International plc, Global Products.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel .

D. Finish: Baked enamel, white .

E. Face Size: 12 by 12 inches .

F. Face Style: Three cone .

G. Mounting: Surface .

H. Pattern: Fixed .

I. Dampers: Butterfly .

2.2 LOUVER FACE DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Nailor Industries Inc.
2. Price Industries.
3. Titus; brand of Johnson Controls International plc, Global Products.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel .

D. Finish: Baked enamel, white .

E. Mounting: T-bar .

F. Pattern: Four-way core style.

G. Dampers: Butterfly .

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13

SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adjustable blade face registers and grilles.
2. Fixed face registers and grilles.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
2. Section 233713.13 "Air Diffusers" for various types of air diffusers.
3. Section 233713.43 "Security Registers and Grilles" for security registers and security grilles.
4. Section 233716 "Fabric Air-Diffusion Devices" for continuous tubular diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 REGISTERS

A. Fixed Face Register :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Nailor Industries Inc.
   b. Price Industries.
   c. Titus, a division of Air System Components; Johnson Controls, Inc.
2. Material: Steel .
3. Finish: Baked enamel, white .
4. Face Blade Arrangement: Horizontal [**Vertical**] spaced 3/4 inch [**1/2 inch**] apart.
5. Core Construction: Integral .
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw .
8. Damper Type: Adjustable opposed blade .
9. Accessory: Filter.

2.2 GRILLES

A. Adjustable Blade Face Grille :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. METALAIRE, Inc.
   b. Price Industries.
   c. Titus, a division of Air System Components; Johnson Controls, Inc.
2. Material: Steel .
3. Finish: Baked enamel, white .
4. Face Blade Arrangement: Horizontal Vertical spaced 3/4 inch 1/2 inch apart.
5. Core Construction: Integral .
6. Rear-Blade Arrangement: [**Horizontal**] Vertical spaced 3/4 inch 1/2 inch apart.
7. Frame: 1-1/4 inches wide.
8. Mounting: Countersunk screw .
9. Accessories:
   a. -blade gang operator.

B. Fixed Face Grille :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Nailor Industries Inc.
   b. Price Industries.
   c. Titus, a division of Air System Components; Johnson Controls, Inc.
2. Material: Steel .
3. Finish: Baked enamel, white .
4. Face Blade Arrangement: Horizontal ; spaced 3/4 inch 1/2 inch apart.
5. Core Construction: Integral .
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw .
8. Accessory: Filter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

SECTION 234100 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pleated panel filters.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:

1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
2. Comply with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PLEATED PANEL FILTERS

A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AAF International.
   b. AirGuard; Clarcor Air Filtration Products, Inc.
   c. Camfil Farr.
   d. Flanders Corporation.

B. Capacities and Characteristics:

1. Depth: 2 inches nominal.
2. Minimum Efficiency Reporting Value: MERV 8 , with "Composite Average Particle Size Efficiency, Percent in Size Range, Micrometers" according to ASHRAE 52.2.
3. Access: Side.

C. Media: Cotton and synthetic fibers coated with nonflammable adhesive.

1. Separators shall be bonded to the media to maintain pleat configuration.
2. Welded-wire grid shall be on downstream side to maintain pleat.
3. Media shall be bonded to frame to prevent air bypass.
4. Support members on upstream and downstream sides to maintain pleat spacing.

D. Filter-Media Frame: Cardboard frame with perforated metal retainer sealed or bonded to the media.

PART 3 - EXECUTION

3.1 INSTALLATION OF FILTERS

A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

B. Install filters in position to prevent passage of unfiltered air.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

D. Coordinate filter installations with duct and air-handling-unit installations.

END OF SECTION 234100

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:

1. Product Data: For refrigerants, indicating compliance with refrigerant management practices.
2. Product Data: For energy performance.

C. Shop Drawings:

1. Equipment submittals showing Energy Star compliance.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Air conditioners shall be Energy Star Rated

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:
   a. For Compressor: Five year(s) from date of Substantial Completion.

b. For Parts: One year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carrier Corporation.
2. Daikin.
3. First Operations LP.
4. Lennox Industries, Inc.; Lennox International.
5. Trane.
6. YORK; a Johnson Controls company.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
6. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
   c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Filters: Permanent, cleanable.
9. Condensate Drain Pans:
   a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1 .

2) Depth: A minimum of 2 inches deep.

b. Single-wall, stainless-steel sheet.

c. Double-wall, -steel sheet with space between walls filled with foam insulation and moisture-tight seal.

d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

1) Minimum Connection Size: 3/4 inch .

e. Pan-Top Surface Coating: Asphaltic waterproofing compound.

f. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

B. Floor-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
   a. Discharge Grille: Steel with surface-mounted frame .
   b. Insulation: Faced, glass-fiber duct liner.
   c. Drain Pans: Galvanized steel, with connection for drain; insulated.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
6. Air Filtration Section:
   a. General Requirements for Air Filtration Section:
      1) Comply with NFPA 90A.
      2) Minimum MERV according to ASHRAE 52.2.
      3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
   b. Disposable Panel Filters:
      1) Factory-fabricated, viscous-coated, flat-panel type.
      2) Thickness: 1 inch .
      3) MERV according to ASHRAE 52.2: 5 .
      4) Media: Interlaced glass fibers sprayed with nonflammable adhesive.
      5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

C. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.

2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
   c. Enclosure Type: Totally enclosed, fan cooled.
   d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
   e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
   f. Mount unit-mounted disconnect switches on exterior of unit.
   g. .
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:
   a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1 .
      2) Depth: A minimum of 1 inch deep.
   b. Single-wall, stainless-steel sheet.
   c. Double-wall, -steel sheet with space between walls filled with foam insulation and moisture-tight seal.
   d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
      1) Minimum Connection Size: 3/4 inch .
   e. Pan-Top Surface Coating: Asphaltic waterproofing compound.
8. Air Filtration Section:
   a. General Requirements for Air Filtration Section:
      1) Comply with NFPA 90A.
      2) Minimum MERV according to ASHRAE 52.2.
      3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
   b. Disposable Panel Filters:
      1) Factory-fabricated, viscous-coated, flat-panel type.
      2) Thickness: 1 inch .
      3) MERV according to ASHRAE 52.2: 5 .
      4) Media: Interlaced glass fibers sprayed with nonflammable adhesive.
      5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

E. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Water Coil Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

END OF SECTION 238126

SECTION 238239.19 - WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.3 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. INDEECO.
2. Markel Products; TPI Corporation.
3. QMark; Marley Engineered Products.

2.2 DESCRIPTION

A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

A. Front Panel: Stamped-steel louver , with removable panels fastened with tamperproof fasteners.

B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

C. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

A. Fan: Aluminum propeller directly connected to motor.

B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

A. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.

B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wall and ceiling unit heaters to comply with NFPA 90A.

B. Install wall and ceiling unit heaters level and plumb.

C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements applicable to Work specified in Division 26.

B. Related Requirements:

1. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. 8PSJ or 8P8C: Miniature 8-position series jack, also called an 8-position 8-contact modular jack for some applications.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. CO/ALR: Copper-aluminum, revised.
17. COPS: Critical operations power system.
18. CU or Cu: Copper.
19. CU-AL or AL-CU: Copper-aluminum.
20. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
21. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
22. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
23. dBm: Decibel absolute power with respect to 1 mW.

24. DC or dc: Direct current.
25. DCOA: Designated critical operations area.
26. DDC: Direct digital control (HVAC).
27. EGC: Equipment grounding conductor.
28. EMF: Electromotive force.
29. EMI: Electromagnetic interference.
30. EPM: Electrical preventive maintenance.
31. EPS: Emergency power supply.
32. EPSS: Emergency power supply system.
33. ESS: Energy storage system.
34. EV: Electric vehicle.
35. EVPE: Electric vehicle power export equipment.
36. EVSE: Electric vehicle supply equipment.
37. fc: Footcandle, a unit of illuminance equal to one lumen per square foot.
38. FLC: Full-load current.
39. ft: Foot.
40. GEC: Grounding electrode conductor.
41. GFCI: Ground-fault circuit interrupter.
42. GFPE: Ground-fault protection of equipment.
43. GND: Ground.
44. HACR: Heating, air conditioning, and refrigeration.
45. HDPE: High-density polyethylene.
46. HID: High-intensity discharge.
47. HP or hp: Horsepower.
48. HVAC: Heating, ventilating, and air conditioning.
49. Hz: Hertz.
50. IBT: Intersystem bonding termination.
51. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
52. IP: Ingress protection rating (enclosures); Internet protocol (communications).
53. IR: Infrared.
54. IS: Intrinsically safe.
55. IT&R: Inspecting, testing, and repair.
56. ITE: Information technology equipment.
57. kAIC: Kiloampere interrupting capacity.
58. kcmil or MCM: One thousand circular mils.
59. kV: Kilovolt.
60. kVA: Kilovolt-ampere.
61. kVAr or kVAR: Kilovolt-ampere reactive.
62. kW: Kilowatt.
63. kWh: Kilowatt-hour.
64. LAN: Local area network.
65. lb: Pound (weight).
66. LCD: Liquid-crystal display.
67. LCDI: Leakage-current detector-interrupter.
68. LED: Light-emitting diode.
69. LNG: Liquefied natural gas.
70. LP-Gas: Liquefied petroleum gas.
71. LRC: Locked-rotor current.
72. MCC: Motor-control center.
73. MDC: Modular data center.

74. MG set: Motor-generator set.
75. MIDI: Musical instrument digital interface.
76. MLO: Main lugs only.
77. MVA: Megavolt-ampere.
78. mW: Milliwatt.
79. MW: Megawatt.
80. MWh: Megawatt-hour.
81. NC: Normally closed.
82. NiCd: Nickel cadmium.
83. NIU: Network interface unit.
84. NO: Normally open.
85. NPT: National (American) standard pipe taper.
86. OCPD: Overcurrent protective device.
87. ONT: Optical network terminal.
88. PC: Personal computer.
89. PCS: Power conversion system.
90. PCU: Power-conditioning unit.
91. PF or pf: Power factor.
92. PHEV: Plug-in hybrid electric vehicle.
93. PLC: Programmable logic controller.
94. PLFA: Power-limited fire alarm.
95. PoE: Power over Ethernet.
96. PV: Photovoltaic.
97. PVC: Polyvinyl chloride.
98. pW: Picowatt.
99. RFI: Radio-frequency interference (electrical); Request for interpretation (contract).
100. RMS or rms: Root-mean-square.
101. RPM or rpm: Revolutions per minute.
102. SCADA: Supervisory control and data acquisition.
103. SCR: Silicon-controlled rectifier.
104. SPD: Surge protective device.
105. sq.: Square.
106. SWD: Switching duty.
107. TCP/IP: Transmission control protocol/Internet protocol.
108. TEFC: Totally enclosed fan-cooled.
109. TR: Tamper resistant.
110. TVSS: Transient voltage surge suppressor.
111. UL: Underwriters Laboratories, Inc. (standards) or UL LLC (services).
112. UL CCN: UL Category Control Number.
113. UPS: Uninterruptible power supply.
114. USB: Universal serial bus.
115. UV: Ultraviolet.
116. V: Volt, unit of electromotive force.
117. V(ac): Volt, alternating current.
118. V(dc): Volt, direct current.
119. VA: Volt-ampere, unit of complex electrical power.
120. VAr: Volt-ampere reactive, unit of reactive electrical power.
121. VFC: Variable-frequency controller.
122. VOM: Volt-ohm-multimeter.
123. VPN: Virtual private network.

124. VRLA: Valve-regulated lead acid.
125. W: Watt, unit of real electrical power.
126. Wh: Watt-hour, unit of electrical energy usage.
127. WPT: Wireless power transfer.
128. WPTE: Wireless power transfer equipment.
129. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit.
7. EPEC-40: Schedule 40 electrical HDPE underground conduit.
8. EPEC-80: Schedule 80 electrical HDPE underground conduit.
9. EPEC-A: Type A electrical HDPE underground conduit.
10. EPEC-B: Type B electrical HDPE underground conduit.
11. ERMC: Electrical rigid metal conduit.
12. ERMC-A: Aluminum electrical rigid metal conduit.
13. ERMC-S: Steel electrical rigid metal conduit.
14. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
15. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
16. ERMC-SS: Stainless steel electrical rigid metal conduit.
17. FMC: Flexible metal conduit.
18. FMC-A: Aluminum flexible metal conduit.
19. FMC-S: Steel flexible metal conduit.
20. FMT: Steel flexible metallic tubing.
21. FNMC: Flexible nonmetallic conduit. See LFNC.
22. HDPE: See EPEC.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.
36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
37. RGS: See ERMC-S-G.
38. RMC: See ERMC.
39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.

41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: Moisture-, heat-, and oil-resistant thermoplastic cable (machine tool wiring).
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.

40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: Thermoset rubber, heat-resistant cable (high heat).
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:

1. Basic Impulse Insulation Level: Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
2. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
3. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
4. Designated Seismic System: A system component that requires design in accordance with ASCE/SEI 7, Ch. 13 and for which the Component Importance Factor is greater than 1.0.
5. Direct Buried: Installed underground without encasement in concrete or other protective material.
6. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to

protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
b. Concrete Box: A box intended for use in poured concrete.
c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
f. Device Box: A box with provisions for mounting a wiring device directly to the box.
g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
o. Raised-Floor Box: A floor box intended for use in raised floors.
p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.

t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

7. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
8. Essential Electrical Systems: Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system. (healthcare facilities)
9. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
10. Jacket: A continuous nonmetallic outer covering for conductors or cables.
11. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
12. Miniature 8-Position Series Jack (8PSJ): Also called an 8-position 8-contact (8P8C) modular jack. An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Shape and dimensions are specified by TIA-1096.
    a. Caution: An 8PSJ is not the same thing as an FCC "registered jack" RJ45S, now called a miniature 8-position keyed jack (8PKJ). Ethernet cable plugs do not have rejection keys. Many manufacturers and suppliers incorrectly use "RJ45" as a generic term to describe any 8-position series plug or jack whether it has a rejection key or not.
13. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
14. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
15. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
16. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
17. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
18. Sheath: A continuous metallic covering for conductors or cables.
19. UL Category Control Number: An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
20. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
    a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.

c. Extra-Low Voltage: Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
d. Low Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
e. Medium Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.

1.3 COORDINATION

A. Arrange to provide temporary electrical power in accordance with requirements specified in Division 01.

1.4 SEQUENCING

A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.5 CLOSEOUT SUBMITTALS

1.6 QUALIFICATIONS

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

A. Substitution requests for electrical equipment will be entertained under the following conditions:

1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

2.2 FACILITY ELECTRICAL PREVENTIVE MAINTENANCE (EPM) PROGRAM BINDERS

A. Description: Set of binders containing operation and maintenance data for facility's electrical equipment that was compiled during analysis of installed electrical Work for Facility EPM Program development.

B. Applicable Standards:

1. Regulatory Requirements: Comply with recommendations in NFPA 70B.
2. General Characteristics:
   a. Volume 1 - Introduction:
      1) Summarize how Facility EPM Program Analysis was performed, how data were collected, and how volumes are organized.
      2) Describe Facility EPM Program and provide recommended policies and procedures for implementing the program and keeping it current.
      3) Provide place for Owner to identify contact information for employees responsible for implementing and maintaining Facility EPM Program.
   b. Volume 2 - Facility Safety, Hazards Awareness, and Emergency Procedures:
      1) Include training requirements for employees and contractors.
      2) Include list of known facility hazards impacting IT&R activities.
      3) Include approval and permitting procedures for IT&R activities.
      4) Include incident emergency response procedures.
      5) Include emergency shutdown procedures.
      6) Include electrical disaster recovery procedures.
   c. Volume 4 - Facility Diagrams and Schedules:
      1) Include single-line diagrams.
      2) Include grounding and bonding diagrams.
      3) Include essential wiring diagrams.
      4) Include records of switchgear, switchboard, and panelboard schedules.
      5) Include time-current curves for overcurrent protective devices.
   d. Volume 11 - Construction Project Closeout Record Documentation:
      1) Include records of power system studies and photometric studies.
      2) Include records of risk assessment studies.
      3) Include records of electrical system startup and commissioning activities.
      4) Include records of baseline inspections and tests.
      5) Include records of baseline infrared photographs with normal light photographs showing the location, direction, angle, and conditions necessary for reproducing each infrared photograph.
      6) Include records of baseline settings for adjustable equipment and devices.

PART 3 - EXECUTION

3.1 DEVELOPMENT OF FACILITY EPM PROGRAM

A. Facility EPM Program must be developed by qualified EPM specialist.

B. Conduct Facility EPM Program analysis in accordance with NFPA 70B recommendations.

C. Compile operation and maintenance data from Facility EPM Program analysis and submit Facility EPM Program Binders.

3.2 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

END OF SECTION 260010

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Metal-clad cable, Type MC, rated 600 V or less.
4. Fire-alarm wire and cable.
5. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
4. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. Cerro Wire LLC.
3. Encore Wire Corporation.
4. General Cable; Prysmian Group North America.

5. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type NM: Comply with UL 83 and UL 719.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
4. Type XHHW-2: Comply with UL 44.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. Cerro Wire LLC.
3. Encore Wire Corporation.
4. General Cable; Prysmian Group North America.
5. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

E. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.
2. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
3. Type XHHW-2: Comply with UL 44.

2.3 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; Atkore International.
2. Alpha Wire Company.
3. Encore Wire Corporation.
4. General Cable; Prysmian Group North America.
5. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multicircuit with color-coded conductors.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors Aluminum, complying with ASTM B800 and ASTM B801.

F. Ground Conductor: Bare .

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Aluminum, interlocked.

I. Jacket: PVC applied over armor.

2.4 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, undefined:

1. Allied Wire & Cable Inc.
2. CommScope, Inc.
3. Superior Essex Inc.
4. West Penn Wire.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG .

D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.5 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M Electrical Products.
2. ABB, Electrification Business.
3. AFC Cable Systems; Atkore International.
4. Gardner Bender.
5. Hubbell Incorporated, Power Systems.
6. Ideal Industries, Inc.
7. ILSCO.
8. NSi Industries LLC.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors must be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. Copper, Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway Multiconductor cable, Type SE.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway .

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway Metal-clad cable, Type MC Nonmetallic-sheathed cable, Type NM. Type NM cable shall be used within dwelling units ONLY.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway .

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway Metal-clad cable, Type MC Nonmetallic-sheathed cable, Type NM. Type NM cable shall be used within dwelling units ONLY.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway .

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

A. Comply with NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 280528 "Pathways for Electronic Safety and Security."

1. Install plenum cable in environmental airspaces, including plenum ceilings.
2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
   a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is permitted.
4. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.

D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backboards.
2. Category 6 balanced twisted pair cable.
3. Control cabling.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inch or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

2.2 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inch. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

B. Painting: Paint plywood on all sides and edges with flat white latex paint. Comply with requirements in Section 099123 "Interior Painting."

2.3 CATEGORY 6 BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 100 MHz.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMP NETCONNECT; a TE Connectivity Ltd. company.
2. Belden Inc.
3. Berk-Tek Leviton; a Nexans/Leviton alliance.
4. CommScope, Inc.
5. General Cable; Prysmian Group North America.
6. Mohawk; a division of Belden Networking, Inc.

C. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 6 cables.

D. Conductors: 100 ohm, No. 24 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP) .

F. Cable Rating: Plenum.

G. Jacket: Blue thermoplastic.

2.4 CONTROL CABLE

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. PVC insulation.
2. Unshielded.
3. PVC jacket.
4. Flame Resistance: Comply with NFPA 262.

2.5 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. CommScope, Inc.
3. Comtran Corporation.
4. Genesis Cable Products; Honeywell International, Inc.
5. nVent (PYROTENAX).
6. Prysmian Cables and Systems; Prysmian Group North America.
7. Superior Essex Inc.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG .

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Control-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Low-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

1. Outlet boxes must be no smaller than 4 inch square by 2-1/8 inch deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
2. Flexible metal conduit must not be used.

B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.

4. Extend conduits 3 inch above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96 inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inch and not more than 6 inch from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lay on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire must be copper, and grounding methods must comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inch above ceilings by cable supports not more than 30 inch apart.
3. Cable must not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of 72 inch <**Insert dimension**> of cable in a coil not less than [**12 inch**] in diameter.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.5 GROUNDING

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

3.6 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers must use label stocks, laminating adhesives, and inks complying with UL 969.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire must have a unique tag.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. Burndy; Hubbell Incorporated, Construction and Energy.
3. ERICO; nVent.
4. ILSCO.
5. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
6. Siemens Industry, Inc., Energy Management Division.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inch in cross section, with 9/32-inch holes spaced 1-1/8 inch apart. Stand-off insulators for mounting must comply with UL 891 for use in switchboards, 600 V and must be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Mechanical-Type Bus-Bar Connectors: Cast silicon bronze, solderless compression -type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Compression-Type Bus-Bar Connectors: Copper or copper alloy, with two wire terminals.

E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

G. Water Pipe Clamps:

1. U-bolt type with malleable-iron clamp and copper ground connector .

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel ; 3/4 inch by 10 ft. .

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG <**Insert wire size>** and smaller, and stranded conductors for No. 6 AWG <**Insert wire size>** and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG <**Insert wire size>** minimum.

1. Bury at least 30 inch below grade.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.

3.2 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
5. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Allied Tube & Conduit; Atkore International.
   c. B-line; Eaton, Electrical Sector.
   d. CADDY; nVent.
   e. Flex-Strut Inc.
   f. Unistrut; Atkore International.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

3. Material for Channel, Fittings, and Accessories: Galvanized steel .
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti, Inc.
      2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) B-line; Eaton, Electrical Sector.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti, Inc.
      4) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101
2. NECA NEIS 102.
3. NECA NEIS 105.
4. NECA NEIS 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."

D. Provide vibration controls with hangers and supports in accordance with requirements specified in

E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps .

G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT IMC and ERMC may be supported by openings through structure members, in accordance with NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To New Concrete: Bolt to concrete inserts.
2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
3. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT-S raceways and elbows.
2. Type ERMC-S raceways, elbows, couplings, and nipples.
3. Type FMC-S and Type FMC-A raceways.
4. Type LFMC raceways.
5. Type PVC raceways and fittings.
6. Fittings for conduit, tubing, and cable.
7. Threaded metal joint compound.
8. Solvent cements.
9. Surface metal raceways and fittings.
10. Wireways and auxiliary gutters.
11. Metallic outlet boxes, device boxes, rings, and covers.
12. Nonmetallic outlet boxes, device boxes, rings, and covers.
13. Cabinets, cutout boxes, junction boxes, and pull boxes.
14. Cover plates for device boxes.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Wireways and auxiliary gutters.
2. Surface metal raceways.
3. Floor boxes.
4. Cabinets and cutout boxes.

PART 2 - PRODUCTS

2.1 TYPE ERMC-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

2. General Characteristics: UL 6 and UL Category Control Number DYIX.

B. Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit; Atkore International.
   b. Calconduit; Atkore International.
   c. Crouse-Hinds; Eaton, Electrical Sector.
   d. Killark; Hubbell Incorporated, Construction and Energy.
   e. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
   f. Western Tube; Zekelman Industries.
2. Exterior Coating: Zinc.
3. Options:
   a. Interior Coating: Zinc with organic top coating .
   b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.2 TYPE LFMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 360 and UL Category Control Number DXHR.

B. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Anaconda Sealtite; Anamet Electrical, Inc.
   c. Electri-Flex Company.
   d. International Metal Hose Co.
2. Material: Steel.
3. Options:
   a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.3 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL Category Control Number DZYR.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Calconduit; Atkore International.
   c. JM Eagle; J-M Manufacturing Co., Inc.
2. Dimensional Specifications: Schedule 40.
3. Options:
   a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.4 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Fittings for Type ERMC, Type IMC, and Type PVC Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Crouse-Hinds; Eaton, Electrical Sector.
   c. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   e. Southwire Company.
2. General Characteristics: UL 514B and UL Category Control Number DWTT.
3. Options:
   a. Material: Steel .
   b. Coupling Method: Compression coupling .
   c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
   d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

C. Fittings for Type EMT Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit; Atkore International.
   b. Crouse-Hinds; Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   e. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   f. Southwire Company.
2. General Characteristics: UL 514B and UL Category Control Number FKAV.
3. Options:
   a. Material: Steel .
   b. Coupling Method: Compression coupling .
   c. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.5 WIREWAYS AND AUXILIARY GUTTERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 870 and UL Category Control Number ZOYX.

B. Metal Wireways and Auxiliary Gutters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. B-line; Eaton, Electrical Sector.
   c. Hoffman; nVent.
   d. Square D; Schneider Electric USA.
   e. Wiegmann; Hubbell Incorporated, Commercial and Industrial.
2. Additional Characteristics:
   a. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
   b. Finish: Manufacturer's standard enamel finish.
3. Options:
   a. Degree of Protection: Type 1 unless otherwise indicated.
   b. Wireway Covers: Screw-cover type unless otherwise indicated.

2.6 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514A and UL Category Control Number QCIT.

B. Metallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Crouse-Hinds; Eaton, Electrical Sector.
   d. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   e. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Pass & Seymour; Legrand North America, LLC.
   g. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   h. Wiremold; Legrand North America, LLC.

i. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

3. Options:
   a. Material: Sheet steel .
   b. Sheet Metal Depth: Minimum 1.5 inch .
   c. Cast-Metal Depth: Minimum 1.8 inch .
   d. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb .
   e. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

C. Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Crouse-Hinds; Eaton, Electrical Sector.
   c. Killark; Hubbell Incorporated, Construction and Energy.
   d. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   e. Pass & Seymour; Legrand North America, LLC.
   f. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

D. Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Crouse-Hinds; Eaton, Electrical Sector.
   d. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   e. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   g. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
3. Options:
   a. Material: Sheet steel .
   b. Sheet Metal Depth: minimum 1.5 inch .
   c. Cast-Metal Depth: minimum 1.8 inch .

2.7 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514C and UL Category Control Number QCMZ.

B. Nonmetallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   d. Cantex Inc.
   e. Crouse-Hinds; Eaton, Electrical Sector.
   f. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   g. Leviton Manufacturing Co., Inc.
   h. Pass & Seymour; Legrand North America, LLC.
   i. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   j. Wiremold; Legrand North America, LLC.
   k. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

C. Nonmetallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box. Nonmetallic boxes shall be used in dwelling units ONLY.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Allied Tube & Conduit; Atkore International.
   c. Arlington Industries, Inc.
   d. Cantex Inc.
   e. Crouse-Hinds; Eaton, Electrical Sector.
   f. Pass & Seymour; Legrand North America, LLC.
   g. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   h. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2.8 CABINETS, CUTOUT BOXES, JUNCTION BOXES, AND PULL BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
   a. Non-Environmental Characteristics: UL 50.
   b. Environmental Characteristics: UL 50E.

B. Indoor Sheet Metal Cabinets:

1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.

b. B-line; Eaton, Electrical Sector.
c. Crouse-Hinds; Eaton, Electrical Sector.
d. Killark; Hubbell Incorporated, Construction and Energy.
e. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
f. Siemens Industry, Inc., Building Technologies Division.
g. Square D; Schneider Electric USA.

3. Additional Characteristics: UL Category Control Number CYIV.
4. Options:
   a. Degree of Protection: Type 1 .

2.9 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
   a. Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
   b. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Metallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   c. Crouse-Hinds; Eaton, Electrical Sector.
   d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   e. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   f. Leviton Manufacturing Co., Inc.
   g. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   h. Pass & Seymour; Legrand North America, LLC.
   i. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   j. Wiremold; Legrand North America, LLC.
   k. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Options:
   a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
   b. Wallplate Material: Galvanized steel .

C. Nonmetallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   d. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   e. Leviton Manufacturing Co., Inc.

f. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
g. Pass & Seymour; Legrand North America, LLC.
h. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
i. Wiremold; Legrand North America, LLC.
j. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Options:
   a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
   b. Wallplate Material: 0.060 inch thick high-impact thermoplastic (nylon) with smooth finish and color matching wiring device .
   c. Color: White .

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.

B. Outdoors:

1. Exposed and Subject to Physical Damage: ERMC .
2. Concealed Aboveground: EMT .
3. Direct Buried: PVC-40.
4. Concrete Encased Not in Trench: PVC-40 .
5. Concrete Encased in Trench: PVC-40 .

C. Indoors:

1. Exposed and Subject to Physical Damage: ERMC . Subject to physical damage includes the following locations:
   a. Wall mounted raceways below 10' in unfinished areas .
2. Exposed and Not Subject to Physical Damage: EMT .
3. Concealed in Ceilings and Interior Walls and Partitions: EMT .

D. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC and IMC: Provide threaded type fittings unless otherwise indicated.

3.2 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:
   a. Type 3R unless otherwise indicated.
2. Indoors:
   a. Type 1 unless otherwise indicated.

C. Exposed Boxes Installed Less Than 10'-0" Above Floor:

1. Provide cast-metal boxes.
2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF RACEWAYS

A. Installation Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
4. Comply with NECA NEIS 101 for installation of steel raceways.
5. Comply with NECA NEIS 102 for installation of aluminum raceways.
6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
8. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts..
9. Raceway Terminations at Locations Subject to Moisture or Vibration:
   a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG..

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
3. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inch of changes in direction.
4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
6. Support conduit within 12 inch of enclosures to which attached.

7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
8. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:
   a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   b. Where an underground service raceway enters a building or structure.
   c. Conduit extending from interior to exterior of building.
   d. Conduit extending into pressurized duct and equipment.
   e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
   f. Where otherwise required by NFPA 70.
9. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
10. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
11. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
12. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:

1. Types ERMC and IMC:
   a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
2. Types FMC and LFMC:
   a. Comply with NEMA RV 3. Provide a maximum of 72 inch of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
3. Type PVC:
   a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F . Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
   b. PVC conduit shall not be installed in plenum spaces.
   c. Comply with manufacturer's written instructions for solvent welding and fittings.

D. Raceways Embedded in Slabs:

1. Arrange raceways to cross building expansion joints with expansion fittings at right angles to the joint.
2. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.

E. Stub-ups to Above Recessed Ceilings:

1. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

F. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

1. EMT: Provide compression , fittings. Comply with NEMA FB 2.10.
2. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

G. Expansion-Joint Fittings:

1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERMC conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

H. Raceways Penetrating Rooms or Walls with Acoustical Requirements:

1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

3.4 INSTALLATION OF SURFACE RACEWAYS

A. Install surface raceway with a minimum 2 inch radius control at bend points.

B. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

3.5 INSTALLATION OF BOXES AND ENCLOSURES

A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

C. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.

D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

E. Locate boxes so that cover or plate will not span different building finishes.

F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.

G. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.

H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.

I. Set metal floor boxes level and flush with finished floor surface.

J. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

K. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.

L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

M. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
2. Provide gaskets for wallplates and covers.

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING

A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Sleeve seal systems.
3. Grout.
4. Pourable sealants.
5. Foam sealants.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Wall Sleeves, Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, LLC.
   b. CCI Piping Systems.
   c. Flexicraft Industries.
2. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Pipe Sleeves, PVC:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CCI Piping Systems.
   b. GPT; an EnPro Industries company.
   c. Metraflex Company (The).
2. Description: ASTM D1785, Schedule 40.

2.2 SLEEVE SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Flexicraft Industries.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel .
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. W.R. Meadows, Inc.

B. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000 psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.4 POURABLE SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlisle SynTec Incorporated.
2. GAF.
3. Johns Manville; a Berkshire Hathaway company.

B. Description: Single-component, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.5 FOAM SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dow Chemical Company (The).
2. Innovative Chemical Products (Building Solutions Group).

B. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
   a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall and Floor Penetrations:

1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
2. Install steel pipe sleeves. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF SLEEVE SEAL SYSTEMS

A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

B. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 1000 V or Less:

1. Black letters on orange field .
2. Legend: Indicate voltage.

B. Color-Coding for Phase- Identification, 1000 V or Less: Use colors listed below for ungrounded feeder conductors.

1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
2. Colors for 208Y/120 V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
3. Colors for 240 V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
4. Color for Neutral: White .
5. Color for Equipment Grounds: Bare copper Green .
6. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

D. Equipment Identification Labels:

1. Black letters on white field.

2.3 LABELS

A. Self-Adhesive Wraparound Labels: Preprinted , 3 mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
2. Marker for Labels:
   a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
   b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:
   a. 1-1/2 by 6 inch for raceway and conductors.
   b. 3-1/2 by 5 inch for equipment.
   c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch long, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Brady Corporation.
   b. HellermannTyton.
   c. Marking Services, Inc.
   d. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Brady Corporation.
   b. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Carlton Industries, LP.
   b. Champion America.
   c. HellermannTyton.
   d. Ideal Industries, Inc.
   e. Marking Services, Inc.
   f. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. emedco.
   d. Marking Services, Inc.

C. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Brimar Industries, Inc.
   c. Ideal Industries, Inc.
   d. Marking Services, Inc.

e. Reef Industries, Inc.

2. Tape:
   a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
   b. Printing on tape must be permanent and may not be damaged by burial operations.
   c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
   a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
   b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW" .
   c. Inscriptions for Orange Tapes: "CAUTION BURIED FIBER OPTIC LINE BELOW" "CAUTION BURIED COMMUNICATION LINE BELOW" .
4. Tape Type I :
   a. Pigmented polyolefin, bright colored, compounded for direct-burial service.
   b. Width: 3 inch.
   c. Thickness: 4 mil.
   d. Weight: 18.5 lb/1000 sq. ft.
   e. Tensile in accordance with ASTM D882: 30 lbf and 2500 psi.

D. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch .

2.6 TAGS

A. Write-on Tags:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brimar Industries, Inc.
   b. Carlton Industries, LP.
   c. LEM Products Inc.
   d. Seton Identification Products; a Brady Corporation company.
2. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags:
   a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
   b. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

I. Self-Adhesive Labels:

1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.

J. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

K. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

L. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

M. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

N. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

O. Write-on Tags:

1. Place in location with high visibility and accessibility.
2. Secure using plenum-rated cable ties.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels .

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.

D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags self-adhesive labels with conductor or cable designation, origin, and destination.

E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes self-adhesive labels with conductor designation.

F. Conductors to Be Extended in Future: Attach write-on tags marker tape to conductors.

G. Workspace Indication: Apply [**or**] tape and stencil to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels .

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
   a. Power-transfer switches.
   b. Controls with external control power connections.

I. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label .

END OF SECTION 260553

SECTION 260573.13 - SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, fault-current study to determine minimum interrupting capacity of circuit protective devices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Short-Circuit Study Report:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form.
   a. Short-circuit study input data, including completed computer program input data sheets.
   b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
   c. Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.3 QUALITY ASSURANCE

A. Software algorithms must comply with requirements of standards and guides specified in this Section.

PART 2 - PRODUCTS

2.1 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kVA and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by study.

D. Comments and recommendations for system improvements or revisions in written document, separate from one-line diagram.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600 V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data:

1. One-line diagram of system being studied.
2. Power sources available.
3. Manufacturer, model, and interrupting rating of protective devices.
4. Conductors.
5. Transformer data.

G. Short-Circuit Study Output Reports:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Equivalent impedance.
2. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain data necessary for conduct of study.

B. Gather and tabulate required input data to support short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

3.2 SHORT-CIRCUIT STUDY

A. Perform study following general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 5 kA or less.
2. Exclude equipment supplied by single transformer smaller than 75 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement to address asymmetrical requirements of interrupting equipment.

H. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

I. Include in report identification of protective device applied outside its capacity.

END OF SECTION 260573.13

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electronic time switches.
2. Outdoor photoelectric switches, solid state, flexible mounting.
3. Outdoor photoelectric switches, low voltage.
4. Indoor occupancy and vacancy sensors.
5. Switchbox-mounted occupancy sensors.
6. Conductors and cables.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Intermatic, Inc.
2. Or equal with prior approval

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Contact Rating: 30 A inductive or resistive, 240 V(ac) .
3. Programs:

a. Eight on-off set points on a 24-hour schedule.
b. .

4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
5. Automatic daylight savings time changeover.
6. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Intermatic, Inc.
2. Or equal with prior approval

B. Description: Solid state, with SPST dry contacts rated for 1000 W incandescent or 1800 VA inductive , to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range , and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Failure Mode: Luminaire stays ON.

2.3 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Leviton Manufacturing Co., Inc.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. Lutron Electronics Co., Inc.
5. Sensor Switch, Inc.
6. WattStopper; Legrand North America, LLC.

B. General Requirements for Sensors:

1. WallorCeiling-mounted, solid-state indoor occupancy and vacancy sensors, as indicated on drawings.
2. Passive infrared Dual technology.
3. Separate power pack.
4. Hardwired connection to switch .

5. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
6. Operation:
   a. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
7. Power Pack: Dry contacts rated for 20 A ballast or LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
8. Mounting:
   a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
   b. Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
9. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
10. Bypass Switch: Override the "on" function in case of sensor failure.
11. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. PIR Type: Wall mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch.
2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.
3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 ft. when mounted on a 10 ft. high ceiling.

D. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Leviton Manufacturing Co., Inc.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. Lutron Electronics Co., Inc.
5. Sensor Switch, Inc.
6. WattStopper; Legrand North America, LLC.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox .

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
4. Switch Rating: Not less than 800 VA ballast or LED load at 120 V, 1200 VA ballast or LED load at 277 V, and 800 W incandescent.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION OF SENSORS

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

3.2 INSTALLATION OF WIRING

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.

C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems.

B. Label time switches and contactors with a unique designation.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Key interlock scheme drawing and sequence of operations.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1 .
   b. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, .
2. Height: 84 inches maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

F. Phase, Neutral, and Ground Buses: Tin-plated aluminum .

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum .
2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
3. Ground Lugs and Bus-Configured Terminators: type, with a lug on the bar for each pole in the panelboard.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

H. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; Schneider Electric USA.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers .

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; Schneider Electric USA.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Plug-in and Bolt-on circuit breakers, replaceable without disturbing adjacent units.

1. Plug-in circuit breakers shall be used only in dwelling unit load centers. All house and commercial tenant panelboards shall utilize bolt-on circuit breakers only.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

E. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; Schneider Electric USA.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:
   a. Inverse time-current element for low-level overloads.
   b. Instantaneous magnetic trip element for short circuits.
   c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
5. MCCB Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Breaker handle indicates tripped status.
   c. UL listed for reverse connection without restrictive line or load ratings.
   d. Lugs: style, suitable for number, size, trip ratings, and conductor materials.
   e. Ground-Fault Protection: relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
   g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
   h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder .

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Mount top of trim 90 inches above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box.

E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

H. Install filler plates in unused spaces.

I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

END OF SECTION 262416

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes work to accommodate utility company revenue meters, and Owner's electricity meters used to manage the electrical power system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For electricity-metering equipment.

1. Include elevation views of front panels of control and indicating devices and control stations.
2. Include diagrams for power, signal, and control wiring.
3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include series-combination rating data for modular meter centers with main disconnect device.

1.3 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
2. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

1.4 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and utility-furnished components.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 916.

2.2 UTILITY METERING INFRASTRUCTURE

A. Utility-Furnished Meters: Connect data transmission facility of metering equipment installed by the Utility.

B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

C. Meter Sockets:

1. Comply with requirements of electrical-power utility company.
2. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

D. Modular Meter Center: Factory-coordinated assembly of a main service disconnect device, wireways, meter socket modules, and feeder circuit breakers arranged in adjacent vertical sections complete with interconnecting buses.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton.
   b. Siemens Industry, Inc., Energy Management Division.
   c. Square D; Schneider Electric USA.
2. Comply with requirements of utility company for meter center.
   a. Comply with UL 67.
3. Housing: NEMA 250, Type 1 enclosure.
4. Meter Socket Rating: Coordinated with connected feeder circuit rating.
5. Minimum Short-Circuit Rating: 100,000 A symmetrical at rated voltage.
6. Steady-state and short-circuit current ratings shall have ratings that match connected circuit ratings.
7. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers and having an adjustable magnetic trip setting for circuit-breaker frame sizes of 250 A and larger. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers." Circuit breakers shall be operable from outside the enclosure to disconnect the unit. Configure cover so it can be opened only when the disconnect switch is open.
8. Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect downstream circuit breakers and to house load centers and panelboards that have 10,000 - A interrupting capacity.
   a. Identification: Complying with requirements in Section 260553 "Identification for Electrical Systems."

b. Physical Protection: Tamper resistant, with hasp for padlock.

9. Surge Protection for Main Disconnect: Factory installed, integrally mounted, UL 1449 Type 1. Comply with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."

E. Arc-Flash Warning Labels:

1. Labels: Comply with requirements for "Self-Adhesive Equipment Labels" and "Signs" in Section 260553 "Identification for Electrical Systems." Apply a properly sized self-adhesive label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
   a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
      1) Location designation.
      2) Nominal voltage.
      3) Flash protection boundary.
      4) Hazard risk category.
      5) Incident energy.
      6) Working distance.
      7) Engineering report number, revision number, and issue date.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install modular meter center according to switchboard installation requirements in NECA 400.

D. Wiring Method:

1. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 271513 "Communications Copper Horizontal Cabling."
3. Minimum conduit size shall be 1/2 inch.

E. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 262713

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade single straight-blade receptacles.
3. General-grade duplex straight-blade receptacles.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Toggle switches.
2. Maintained-contact switches.
3. Momentary-contact switches.
4. Rocker switches.
5. Single straight-blade receptacles
6. Duplex straight-blade receptacles.

1.3 WARRANTY FOR DEVICES

A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

A. Toggle Switch :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
   a. Reference Standards: UL CCN WMUZ and UL 20.
4. Options:
   a. Device Color: White Office White .
   b. Configuration:
      1) General-duty, 120-277 V, 15 A, single pole and three way .
      2) General-duty, 120-277 V, 20 A, single pole and three way .
5. Accessories:
   a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
   b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

A. Single Straight-Blade Receptacle :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
   a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
   a. Device Color: White .
   b. Configuration:
      1) Heavy-duty, NEMA 14-30R (Dryer) NEMA 14-50R (Range) .

5. Accessories:
   a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
   b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Tamper-Resistant Duplex Straight-Blade Receptacle :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
   a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
   a. Device Color: White .
   b. Configuration:
      1) General-duty, NEMA 5-15R in dwelling units,NEMA 5-20R in all other areas.
5. Accessories:
   a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
   b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

B. Cord Reels:

1. Examine roughing-in for cord reel mounting and power connections to verify actual locations of mounts and power connections before cord reel installation.
2. Examine walls, floors, and ceilings for suitable conditions where cord reel will be installed.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF CONTROLLED AND UNCONTROLLED RECEPTACLES

A. Private and Open Office Spaces:

1. Uncontrolled Receptacles at Workstations: Coordinate final locations of receptacles with furniture plan such that at least one uncontrolled receptacle is selected for installation not greater than 6 ft from each workstation.
2. Controlled Receptacles at Workstations: Coordinate final locations of receptacles with furniture plan such that at least one controlled receptacle is selected for installation not greater than 6 ft from each workstation.
3. Contact Architect for resolution of discrepancies between these requirements and Drawings.

3.3 SELECTION OF GFCI RECEPTACLES

A. Healthcare Facilities: Unless protection of downstream branch-circuit wiring, cord sets, and power-supply cords is required by NFPA 70 or NFPA 99, provide non-feed-through GFCI receptacles.

3.4 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Architect for resolution of conflicting requirements.

3.5 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

3.6 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

B. Cord Reels and Fittings:

1. After installation, protect cord reels and fittings from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

C. Connectors, Cords, and Plugs:

1. After installation, protect connectors, cords, and plugs from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
   a. Enclosed switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bussmann; Eaton, Electrical Sector.
2. Littelfuse, Inc.
3. Mersen USA.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 250 -V, zero- to 600-A rating, 200 kAIC , time delay.
2. Type L: 600-V, 601- to 6000-A rating, 200 kAIC , time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by .

3.2 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.3 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 240 -V ac.
4. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
5. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
3. Service-Rated Switches: Labeled for use as service equipment.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 240 -V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

END OF SECTION 262816

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
2. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

1.2 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.4 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 5 to 104 deg F.

1. Relative Humidity: Zero to 95 percent.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
   a. "USE ONLY" and include specific lamp type.
   b. Lamp diameter, shape, size, wattage, and coating.
   c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage .

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."

B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

END OF SECTION 265119

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.5 FIELD CONDITIONS

A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 1598 and listed for wet location.

C. CRI of minimum 70 . CCT as indicated on drawings. .

D. L70 lamp life of 50,000 hours.

E. Source Limitations:

1. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

C. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

D. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

E. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Wall-Mounted Luminaire Support:

1. Attached to a minimum 1/8 inch backing plate attached to wall structural members .

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

H. Coordinate layout and installation of luminaires with other construction.

I. Adjust luminaires that require field adjustment or aiming.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.2 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 265619

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding rods.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Comply with TIA-607-B.

2.2 CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Harger Lightning & Grounding.
2. Panduit Corp.
3. TE Connectivity Ltd.

B. Comply with UL 486A-486B.

C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Tray Equipment Grounding Wire: No. 6 AWG.

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
4. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Hubbell Incorporated, Construction and Energy.
2. Harger Lightning & Grounding.
3. Panduit Corp.
4. TE Connectivity Ltd.

B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

D. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.

E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Harger Lightning & Grounding.
2. Panduit Corp.

B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.

3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.5 GROUND RODS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Harger Lightning & Grounding.
2. TE Connectivity Ltd.

B. Ground Rods: Copper-clad steel ; 3/4 inch by 10 feet in diameter.

2.6 IDENTIFICATION

A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with TIA-607-B.

3.3 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

B. Underground Grounding Conductors: Install bare copper conductor, No. 4 AWG minimum.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch intervals.
4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
   a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 1/0 No. 3/0 AWG.

3.5 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pretwist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer

conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. .

3.7 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

END OF SECTION 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetallic wireways and auxiliary gutters.
5. Hooks.

1.2 ACTION SUBMITTALS

A. Product data for each type of product.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 GENERAL

A. Install communications systems cabling in conduit or cable tray where exposed. Individual or bundled cables routed in exposed ceiling areas are not acceptable.

B. Communications systems cabling may be supported by J hooks where concealed by ceilings.

2.2 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; Atkore International.
2. Allied Tube & Conduit; Atkore International.
3. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
4. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
5. Southwire Company.
6. Wheatland Tube; Zekelman Industries.

C. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

D. GRC: Comply with ANSI C80.1 and UL 6.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Fittings for EMT:
   a. Material: Steel .
   b. Type: Setscrew .
2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

G. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.3 NONMETALLIC CONDUITS AND FITTINGS

A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; Atkore International.
2. Allied Tube & Conduit; Atkore International.
3. Condux International, Inc.
4. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

C. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-D.

D. RNC: Type EPC-40-PVC , complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. Rigid HDPE: Comply with UL 651A.

F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.4 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. MonoSystems, Inc.
2. Panduit Corp.
3. Wiremold; Legrand North America, LLC.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

E. Galvanized steel.

F. J shape.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Minimum Pathway Size: 3/4-inch trade size for copper and aluminum cables, and 1 inch for optical-fiber cables.

B. Pathway Fittings: Compatible with pathways and suitable for use and location.

C. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

D. Install surface pathways only where indicated on Drawings.

E. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F .

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

G. Complete pathway installation before starting conductor installation.

H. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

I. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

J. Support conduit within 12 inches of enclosures to which attached.

K. Pathways Embedded in Slabs:

1. Run conduit parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
3. Arrange pathways to keep a minimum of 1 inch of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from nonmetallic conduit and fittings to RNC, Type EPC-40-PVC, and fittings before rising above floor.

L. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

N. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

R. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

S. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

T. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet o.c.
5. Provide a hook at each change in direction.

X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Y. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Install backfill.
2. After installing conduit, backfill and compact.
3. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete around conduit for a minimum of 12 inches on each side of the coupling.
   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
4. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.5 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

B. Related Requirements:

1. Section 270548 "Seismic Controls for Communications Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fabrication and installation details for communications hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Aluminum slotted-channel systems.
4. Nonmetallic slotted-channel systems.
5. Equipment supports.
6. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles, with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel .
3. Channel Width: 1-5/8 inches .
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
6. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M,Grade A325 .
6. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-C.
4. NECA 101.
5. NECA 105.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps .

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. Instead of expansion anchors, powder-actuated-driven threaded studs, provided with lock washers and nuts, may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
5. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor communications materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

END OF SECTION 270529

SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Pourable sealants.
3. Foam sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Pipe Sleeves, PVC:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CCI Piping Systems.
   b. GPT; an EnPro Industries company.
   c. Metraflex Company (The).
2. Description: ASTM D1785, Schedule 40.

2.2 POURABLE SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlisle SynTec Incorporated.
2. GAF.

3. Johns Manville; a Berkshire Hathaway company.

B. Description: Single-component, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.3 FOAM SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dow Chemical Company (The).
2. Innovative Chemical Products (Building Solutions Group).

B. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
   a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   b. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless sleeve seal system is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

END OF SECTION 270544

SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cable ties.
2. Miscellaneous identification products.
3. Labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70 and TIA 606-B.

B. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Brother International Corporation.
   c. HellermannTyton.
   d. Ideal Industries, Inc.
   e. Panduit Corp.
2. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Verify identity of each item before installing identification products.

C. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

D. Apply identification devices to surfaces that require finish after completing finish work.

E. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

F. Cable Ties: General purpose, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

END OF SECTION 270553

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backboards.
2. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.
2. Section 271323 "Communications Optical Fiber Backbone Cabling" for optical-fiber data cabling associated with system panels and devices.
3. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.
4. Section 271523 "Communications Optical Fiber Horizontal Cabling" for coaxial data cabling associated with system panels and devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.

B. Backboard Paint: Light-colored fire-retardant paint .

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arlington Industries, Inc.
2. Crouse-Hinds; Eaton, Electrical Sector.
3. Hoffman; nVent.

4. Hubbell Incorporated.
5. Milbank Manufacturing Co.
6. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
7. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
8. Wiremold; Legrand North America, LLC.
9. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets shall be listed and labeled for intended location and use.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, Type FD, ferrous alloy , with gasketed cover.

E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

F. Device Box Dimensions: 4 inches square by 2-1/8 inches deep .

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

G. Backboards:

1. Install from 6 inches to 8 feet, 6 inches above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
2. Paint all sides of backboard with two coats of paint.
3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

3.2 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual", "Firestopping Practices" Ch.

END OF SECTION 271100

SECTION 271116 - COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. 19-inch equipment racks.
2. Labeling.

1.2 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

B. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. UL listed.

B. RoHS compliant.

2.2 19-INCH EQUIPMENT RACKS

A. Description: four- post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch equipment mounting with an opening of 17.72-inches between rails.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chatsworth Products, Inc.
2. B-line; Eaton, Electrical Sector.
3. Belden Inc.
4. CommScope, Inc.

5. Dell Technologies Inc.
6. Leviton Manufacturing Co., Inc.
7. Panduit Corp.
8. Tripp-Lite.

C. General Requirements:

1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Material: Extruded steel .
3. Finish: Manufacturer's standard, baked-polyester powder coat.
4. Color: Black .

D. Floor-Mounted Racks:

1. Overall Height: 84 inches .
2. Overall Depth: 29 inches .
3. Upright Depth: [**3 inches**]
4. Four-Post Load Rating: 1000 lb .
5. Number of Rack Units per Rack: 45 .
6. Threads: 12-24 .
7. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug.
8. Base shall have a minimum of four mounting holes for permanent attachment to floor.
9. Top shall have provisions for attaching to cable tray or ceiling.
10. Self-leveling.

E. Cable Management:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.3 LABELING

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout of communications equipment spaces.

C. Comply with BICSI ITSIMM for installation of communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in racks and room. Coordinate service entrance configuration with service provider.

1. Meet jointly with system providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment spaces to accommodate and optimize configuration and space requirements of telecommunications equipment.
4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 IDENTIFICATION

A. Coordinate system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 270553 "Identification for Electrical Systems."

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.

D. Labels shall be machine printed. Type shall be 1/8 inch in height.

END OF SECTION 271116

SECTION 271323 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. 62.5/125-micrometer, multimode, optical fiber cable (OM1).

1.2 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics including the following:
    a. Telecommunications rooms plans and elevations.
    b. Telecommunications pathways.
    c. Telecommunications system access points.
    d. Cross-connects.
    e. Patch panels.
    f. Patch cords.
5. Cross-connects and patch panels.

1.4 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

2.2 62.5/125-MICROMETER, MULTIMODE, OPTICAL FIBER CABLE (OM1)

A. Description: Multimode, 62.5/125-micrometer, [**24**] -fiber, nonconductive, tight buffer, optical fiber cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden, Inc.
2. CommScope, Inc.
3. General Cable; Prysmian Group North America.
4. Mohawk; a division of Belden Networking, Inc.
5. Superior Essex Inc.

C. Standards:

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAA for detailed specifications.

D. Conductive cable shall be steel armored type.

E. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

F. Minimum Overfilled Modal Bandwidth-length Product: 200 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

G. Jacket:

1. Jacket Color: Orange .
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

H. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Riser Rated, Nonconductive: Type OFNR , complying with UL 1666.

2.3 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Technology Systems Industries, Inc.
2. Belden, Inc.
3. CommScope, Inc.
4. Dynacom Corporation.

B. Standards:

1. Comply with Optical Fiber Connector Intermateability Standard specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

2.4 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot- long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 1 .
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.

C. Comply with requirements in Section 271523 "Communications Optical Fiber Horizontal Cabling" for cable and asset management software.

D. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

END OF SECTION 271323

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Cable management system.

1.2 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules:
   a. Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration Drawings and printouts.
3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment.

1.4 QUALITY ASSURANCE

1.5 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated:
   a. Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway .

B. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.

B. Manufacturers: Subject to compliance with requirements, undefined:

1. AMP NETCONNECT; a TE Connectivity Ltd. company.
2. Belden, Inc.
3. CommScope, Inc.
4. General Cable; Prysmian Group North America.
5. Genesis Cable Products; Honeywell International, Inc.
6. Mohawk; a division of Belden Networking, Inc.
7. Superior Essex Inc.
8. SYSTIMAX Solutions; a CommScope Inc. brand.

C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP) .

F. Cable Rating: Plenum.

G. Jacket: Blue thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMP NETCONNECT; a TE Connectivity Ltd. company.
2. Belden, Inc.
3. CommScope, Inc.
4. General Cable; Prysmian Group North America.
5. Genesis Cable Products; Honeywell International, Inc.
6. Mohawk; a division of Belden Networking, Inc.
7. Superior Essex Inc.
8. SYSTIMAX Solutions; a CommScope Inc. brand.

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6 .
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.

E. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:
   a. Universal T568A and T568B wiring labels.
   b. Labeling areas adjacent to conductors.
   c. Replaceable connectors.
   d. 24 or 48 ports.
2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
3. Number of Jacks per Field: One for each four-pair cable indicated .

F. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

G. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568-C.2.
3. Marked to indicate transmission performance.

H. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or cover plate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.

I. Cover Plate:

1. Plastic Cover Plate: High-impact plastic. Coordinate color with Section 260533 "Raceway and Boxes for Electrical Systems."
2. Metal Cover Plate: , complying with requirements in Section 260533 "Raceway and Boxes for Electrical Systems."
3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
   a. Flush mounting jacks, positioning the cord at a 45-degree angle.

PART 3 - EXECUTION

3.1 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. Routing: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

D. General Requirements for Cabling:

1. Comply with TIA-568-C.1.
2. Comply with BICSI's Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
11. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.

3.2 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.3 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

C. Comply with TIA-607-B and NECA/BICSI-607.

D. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

E. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.

C. Equipment grounding conductors.

D. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

E. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.5 MAINTENANCE

END OF SECTION 271513

SECTION 271523 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. 62.5/125-micrometer, multimode, optical fiber cable (OM1).

1.2 OPTICAL FIBER HORIZONTAL CABLING DESCRIPTION

A. Optical fiber horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C and the equipment outlet, otherwise known as "Cabling Subsystem 1," or Distributor C and the equipment outlet, otherwise known as "Centralized Cabling," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration Drawings and printouts.
4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 62.5/125-MICROMETER, MULTIMODE, OPTICAL FIBER CABLE (OM1)

A. Description: Multimode, 62.5/125-micrometer, 1 -fiber, nonconductive , tight buffer, optical fiber cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden, Inc.
2. Berk-Tek Leviton; a Nexans/Leviton alliance.
3. CommScope, Inc.
4. General Cable; Prysmian Group North America.
5. Mohawk; a division of Belden Networking, Inc.
6. Superior Essex Inc.

C. Standards:

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAA for detailed specifications.

D. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

E. Minimum Overfilled Modal Bandwidth-length Product: 200 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

F. Jacket:

1. Jacket Color: Orange .
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

G. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

PART 3 - EXECUTION

3.1 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301 and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot- long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

D. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

E. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

F. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

G. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

H. Group connecting hardware for cables into separate logical fields.

3.2 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.3 GROUNDING

A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

D. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

END OF SECTION 271523

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Addressable fire-alarm system.
2. Fire-alarm control unit (FACU).
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Heat detectors.
6. Multicriteria and multisensor fire detectors.
7. Fire-alarm notification appliances.
8. Fire-alarm remote annunciators.
9. Fire-alarm addressable interface devices.
10. Digital alarm communicator transmitters (DACTs).

B. Related Requirements:

1. Section 087100 "Door Hardware" for magnetic door holders that release in response to fire-alarm outputs.
2. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" or Section 260523 "Control Voltage Electrical Power Cables" for cables and conductors for fire-alarm systems.

1.2 DEFINITIONS

A. DACT: Digital alarm communicator transmitter.

B. FACU: Fire-alarm control unit.

C. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.3 ACTION SUBMITTALS

A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.

B. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

C. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, and details, including details of attachments to other Work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Annunciator panel details as required by authorities having jurisdiction.
5. Detail assembly and support requirements.
6. Include voltage drop calculations for notification-appliance circuits.
7. Include battery-size calculations.
8. Include input/output matrix.
9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
10. Include performance parameters and installation details for each detector.
11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
12. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
    c. Locate detectors in accordance with manufacturer's written instructions.
13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

D. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
2. Installation must be by personnel certified by NICET as fire-alarm Level III technician.
3. Obtain certification by NRTL in accordance with NFPA 72.
4. Licensed or certified by authorities having jurisdiction.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ADDRESSABLE FIRE-ALARM SYSTEM

A. Description:

1. Noncoded, addressable system, with multiplexed signal transmission and horn-and-strobe notification for evacuation.

B. Performance Criteria:

1. Regulatory Requirements:
   a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.
2. General Characteristics:
   a. Automatic sensitivity control of certain smoke detectors.
   b. Fire-alarm signal initiation must be by one or more of the following devices:
      1) Manual stations.
      2) Heat detectors.
      3) Smoke detectors.
      4) Automatic sprinkler system water flow.
      5) Fire pump running.
      6) .
   c. Fire-alarm signal must initiate the following actions:
      1) Identify alarm and specific initiating device at FACU and remote annunciators.
      2) Transmit alarm signal to remote alarm receiving station.
      3) Unlock electric door locks in designated egress paths.
      4) Switch HVAC equipment controls to fire-alarm mode.
      5) Recall elevators to primary or alternate recall floors.
      6) Activate elevator power shunt trip.
      7) Record events in system memory.
      8) .

d. Supervisory signal initiation must be by one or more of the following devices and actions:
   1) Valve supervisory switch.
   2) Elevator shunt-trip supervision.
   3) Fire pump is running.
   4) Fire pump has lost power.
   5) .

e. System trouble signal initiation must be by one or more of the following devices and actions:
   1) Open circuits, shorts, and grounds in designated circuits.
   2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
   3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
   4) Loss of primary power at FACU.
   5) Ground or single break in internal circuits of FACU.
   6) Abnormal ac voltage at FACU.
   7) Break in standby battery circuitry.
   8) Failure of battery charging.
   9) Abnormal position of switch at FACU or annunciator.
   10) .

f. System Supervisory Signal Actions:
   1) Identify specific device initiating event at FACU and remote annunciators.
   2) After time delay of 200 seconds , transmit trouble or supervisory signal to remote alarm receiving station.
   3) Display system status on graphic annunciator.

g. Document Storage Box:
   1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
   2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
   3) Color: Red powder-coat epoxy finish.
   4) Labeling: Permanently screened with 1 inch high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
   5) Security: Locked with 3/4 inch barrel lock. Provide solid 12 inch stainless steel piano hinge.

2.2 FIRE-ALARM CONTROL UNIT (FACU)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Edwards; Carrier Global Corporation.
2. Fire-Lite Alarms; Honeywell International, Inc.
3. Gamewell-FCI; Honeywell International, Inc.
4. Notifier; Honeywell International, Inc.
5. Siemens Industry, Inc., Building Technologies Division.
6. Silent Knight; Honeywell International, Inc.

7. Simplex; Johnson Controls.

B. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.

C. Performance Criteria:

1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
2. General Characteristics:
   a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
   b. Include real-time clock for time annotation of events on event recorder and printer.
   c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
   d. FACU must be listed for connection to central-station signaling system service.
   e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
   f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
      1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
   g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
      1) Annunciator and Display: LCD, 160 characters, minimum.
      2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
   h. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
      1) Pathway Class Designations: NFPA 72, Class A .
      2) Pathway Survivability: Level 0 .
   i. Notification-Appliance Circuit:
      1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
      2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
      3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
   j. Elevator Recall: Initiate by one of the following alarm-initiating devices:
      1) Elevator lobby detectors except lobby detector on designated floor.
      2) Smoke detectors in elevator machine room.
      3) Smoke detectors in elevator hoistway.
   k. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.

l. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.
   1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.

m. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.

n. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
   1) Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
   2) Programmable tone and message sequence selection.
   3) Standard digitally recorded messages for "Evacuation" and "All Clear."
   4) Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of FACU.

o. Status Annunciator: Indicate status of various voice/alarm speaker zones and status of firefighters' two-way telephone communication zones.

p. Preamplifiers, amplifiers, and tone generators must automatically transfer to backup units, on primary equipment failure.

q. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate printing of list of existing alarm, supervisory, and trouble conditions in system and historical log of events.

r. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals supervisory and DACT must be powered by 24 V(dc) source.

s. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.

t. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.

D. Accessories:

1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.

2.3 MANUAL FIRE-ALARM BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Edwards; Carrier Global Corporation.
2. Fire-Lite Alarms; Honeywell International, Inc.
3. Gamewell-FCI; Honeywell International, Inc.
4. Notifier; Honeywell International, Inc.
5. Siemens Industry, Inc., Building Technologies Division.
6. Silent Knight; Honeywell International, Inc.
7. Simplex; Johnson Controls.

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm. Lifting cover actuates integral battery-powered audible horn intended to discourage false-alarm operation.
4. Able to perform at up to 90 percent relative humidity at 90 deg F .
5. Able to be used in indoor areas.

2.4 SYSTEM SMOKE DETECTORS

A. Photoelectric Smoke Detectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Edwards; Carrier Global Corporation.
   b. Fire-Lite Alarms; Honeywell International, Inc.
   c. Gamewell-FCI; Honeywell International, Inc.
   d. Gentex Corporation.
   e. Notifier; Honeywell International, Inc.
   f. Siemens Industry, Inc., Building Technologies Division.
   g. Silent Knight; Honeywell International, Inc.
   h. Simplex; Johnson Controls.
2. Performance Criteria:
   a. Regulatory Requirements:
      1) NFPA 72.
      2) UL 268.
   b. General Characteristics:
      1) Detectors must be two-wire type.
      2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
      3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
      4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
   a) Primary status.
   b) Device type.
   c) Present average value.
   d) Present sensitivity selected.
   e) Sensor range (normal, dirty, etc.).
8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
9) Color: White .
10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
11) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
12) Sensitivity levels based on time of day.

2.5 HEAT DETECTORS

A. Fixed-Temperature-Type Heat Detectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Edwards; Carrier Global Corporation.
   b. Fire-Lite Alarms; Honeywell International, Inc.
   c. Gamewell-FCI; Honeywell International, Inc.
   d. Gentex Corporation.
   e. Notifier; Honeywell International, Inc.
   f. Siemens Industry, Inc., Building Technologies Division.
   g. Silent Knight; Honeywell International, Inc.
   h. Simplex; Johnson Controls.
2. Performance Criteria:
   a. Regulatory Requirements:
      1) NFPA 72.
      2) UL 521.
   b. General Characteristics:
      1) Actuated by temperature that exceeds fixed temperature of 190 deg F .
      2) Mounting: Twist-lock base interchangeable with smoke-detector bases.
      3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
      4) Detector must have functional humidity range of 10 to 90 percent.
      5) Color: White .

2.6 FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Audible Notification Appliances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Edwards; Carrier Global Corporation.
   b. Gentex Corporation.
   c. Notifier; Honeywell International, Inc.
   d. Siemens Industry, Inc., Building Technologies Division.
   e. Simplex; Johnson Controls.
2. Description: Horns, bells, or other notification devices that cannot output voice messages.
3. Performance Criteria:
   a. Regulatory Requirements:
      1) NFPA 72.
   b. General Characteristics:
      1) Individually addressed, connected to signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
      2) Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
      3) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured 10 ft. from horn, using coded signal prescribed in UL 464 test protocol.
      4) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Fire-Alarm Visible Notification Appliances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Edwards; Carrier Global Corporation.
   b. Gentex Corporation.
   c. Notifier; Honeywell International, Inc.
   d. Siemens Industry, Inc., Building Technologies Division.
   e. Simplex; Johnson Controls.
2. Performance Criteria:
   a. Regulatory Requirements:
      1) NFPA 72.
      2) UL 1971.
   b. General Characteristics:
      1) Rated Light Output:
         a) 15/30/75/110 cd, selectable in field.
      2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
      3) Mounting: Wall or ceiling mounted as indicated on drawings.
      4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
      5) Flashing must be in temporal pattern, synchronized with other units.
      6) Strobe Leads: Factory connected to screw terminals.

7) Mounting Faceplate: Factory finished, white.

2.7 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Notifier; Honeywell International, Inc.

B. Performance Criteria:

1. Regulatory Requirements:
   a. NFPA 72.
2. General Characteristics:
   a. Include address-setting means on module.
   b. Store internal identifying code for control panel use to identify module type.
   c. Listed for controlling HVAC fan motor controllers.
   d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
   e. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown .
      1) Allow control panel to switch relay contacts on command.
      2) Have minimum of two normally open and two normally closed contacts available for field wiring.
   f. Control Module:
      1) Operate notification devices.
      2) Operate solenoids for use in sprinkler service.
      3) .

2.8 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Edwards; Carrier Global Corporation.

B. Performance Criteria:

1. Regulatory Requirements:
   a. NFPA 72.
2. General Characteristics:
   a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.
   b. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically capture one telephone line(s) and dial preset number for remote central station. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of telephone line to remote alarm receiving station over remaining

line. Transmitter must automatically report telephone service restoration to central station. If service is lost on both telephone lines, transmitter must initiate local trouble signal.

c. Local functions and display at DACT must include the following:
   1) Verification that both telephone lines are available.
   2) Programming device.
   3) LED display.
   4) Manual test report function and manual transmission clear indication.
   5) Communications failure with central station or FACU.
   6) .

d. Digital data transmission must include the following:
   1) Address of alarm-initiating device.
   2) Address of supervisory signal.
   3) Address of trouble-initiating device.
   4) Loss of ac supply.
   5) Loss of power.
   6) Low battery.
   7) Abnormal test signal.
   8) Communication bus failure.

e. Secondary Power: Integral rechargeable battery and automatic charger.

f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.

B. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 INSTALLATION OF EQUIPMENT

A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before other trades have completed cleanup must be replaced.
2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
2. Mount manual fire-alarm box on background of contrasting color.
3. Operable part of manual fire-alarm box must be between 42 and 48 inch above floor level. Devices must be mounted at same height unless otherwise indicated.

D. Smoke- and Heat-Detector Spacing:

1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing must not exceed 30 ft. .
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inch from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inch from lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch long must be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

H. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.

K. Device Location-Indicating Lights: Locate in public space near device they monitor.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 PATHWAYS

A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inch above floor must be installed in EMT.

B. Pathways must be installed in EMT.

C. Exposed EMT must be painted red enamel.

3.7 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
3. Smoke dampers in air ducts of designated HVAC duct systems.
4. Electronically locked doors and access gates.
5. Alarm-initiating connection to elevator recall system and components.
6. Alarm-initiating connection to activate emergency lighting control.
7. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
8. Supervisory connections at valve supervisory switches.
9. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
10. Supervisory connections at elevator shunt-trip breaker.
11. Data communication circuits for connection to building management system.
12. Data communication circuits for connection to mass notification system.
13. Supervisory connections at fire-extinguisher locations.
14. Supervisory connections at fire-pump power failure including dead-phase or phase-reversal condition.
15. Supervisory connections at fire-pump engine control panel.
16. .

3.8 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Install framed instructions in location visible from FACU.

3.9 GROUNDING

A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.10 FIELD QUALITY CONTROL

A. Field tests must be witnessed by authorities having jurisdiction .

B. Administrant for Tests and Inspections:

1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
   a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
   b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 284621.11

SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE SUPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 210516 "Expansion Fittings and Loops for Fire-Suppression Piping" for pipe guides and anchors.

1.2 ACTION SUBMITTALS

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Comply with NFPA 13 .

B. UL Compliance: Comply with UL 203.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel .

2.3 MATERIALS

A. Aluminum: ASTM B 221 .

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi , 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

C. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

D. Install lateral bracing with pipe hangers and supports to prevent swaying.

E. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

F. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for .

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use thermal hanger-shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 .
2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 .
4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 .
5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 .
6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 .
7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 , with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 , with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 .
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Comply with NFPA requirements.

K. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. C-Clamps (MSS Type 23): For structural shapes.
2. Side-Beam Brackets (MSS Type 34): For sides of steel Purlins.

L. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

M. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

END OF SECTION 210529

SECTION 210533 - HEAT TRACING FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes heat tracing for fire-suppression piping with the following electric heating cables:

1. Self-regulating, parallel resistance.

B. Related Requirements:

1. Section 210700 "Fire Suppression Systems Insulation."
2. Section 220533 "Heat Tracing for Plumbing Piping."
3. Section 230533 "Heat Tracing for HVAC Piping."
4. Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
5. Section 260526 "Grounding and Bonding for Electrical Systems."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include:
   a. Heating cable data sheet.
   b. Fire sprinkler freeze protection design guide.
   c. System installation and operation manual.
   d. System installation details.
   e. Connection kits and accessories data sheet.
   f. Controller data sheet.
   g. Controller wiring diagram.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Schedule heating capacity, length of cable, and electrical power requirement for each electric heating cable required.
4. Include heat loss calculations for each pipe including pipe and insulation characteristics, heat loss, and watts per foot supplied by the heating cable.

B. Shop Drawings: For electric heating cable.

1. Include plans, elevations, sections, and attachment details.

2. Include diagrams for power, signal, and control wiring.
3. Manufacturer to produce detailed design as described below.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Delegated design submittals include:

1. Heat Trace Circuit Layout Drawings, including:
   a. Location/Identification of area to be traced.
   b. Heater circuit number.
   c. Electrical load.
   d. Heater catalog numbers.
   e. Heater termination points.
   f. Start-up temperature.
   g. Location of all components.
   h. Material list and quantities of all components.
   i. Heating cable layout.
2. Heat Trace Isometric, including:
   a. Location of line.
   b. Piping line numbers.
   c. Valves, pumps, flanges, fittings, instruments.
   d. Heat loss and heater output.
   e. Electrical load.
   f. Heater catalog number.
   g. Heater termination points.
   h. Design parameters.
   i. Insulation type and thickness.
   j. Position of all components.
   k. Material schedule listing all components and quantities used.
   l. Panel ID number.
3. Pipe Freeze Protection Detail Drawings: Project-specific Detail Drawings, including details showing:
   a. Installation and positioning of all components.
   b. Proper amounts of tracing for valves, pumps, flanges, fittings, instruments, etc.
   c. Junction box layouts.
4. Control Panel Drawings: Drawings for each control panel shall include the following:
   a. Physical arrangement and structural detail drawings.
   b. Complete power and control wiring diagrams showing all internal wiring connections for electrical and instrument components in each control panel. All wires, terminals, and devices shall be numbered and tagged in accordance with system elementary diagrams.
5. System Wiring Diagram: Project-specific drawings (if applicable) including:
   a. Interconnect of all major components.
   b. Assignment of circuiting.
   c. Connection of circuit wiring in terminal blocks.
   d. Connection of sensor wiring.
   e. Connection of external alarm wiring.
6. Controller Setpoint Schedule (if applicable) showing the following:
   a. Circuit addresses.
   b. Circuit set points.
   c. Circuit alarms and settings.

D. Testing Instructions and Reporting Form: Provide documentation for use in preinstallation testing of heat-tracing system.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

B. Testing: Completed system test report.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. ISO-09001 registered.
2. Provide Products with CSA 22.2 No 130-16 certification and/or UL 515 listing, consistent with IEEE 515.1 requirements.

B. Installer Qualifications:

1. System Installer to have complete understanding of product and product literature from manufacturer or authorized representative prior to installation.
2. Electrical connections to be performed by licensed electrician.

C. Certification: System (Heating Cable, Connection Kits, and Controller): CSA Certified for freeze protection of standpipes, mains, and branch fire sprinkler piping.

D. Testing: Self-regulating heating cable to be qualified and tested to demonstrate a useful lifetime in excess of 20 years.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying the following:

1. Product and Manufacturer.
2. Length/Quantity.
3. Lot Number.
4. Installation and operation Manual.
5. Material Safety Data Sheet (MSDS).

B. Store heating cable in clean, dry location with a temperature range of 0 to 140 deg F.

C. Protect heating cable ends from moisture ingress until final termination of the heating cable is complete.

1.8 WARRANTY

A. Manufacturer Limited Warranty: Manufacturer agrees to repair or replace heat tracing products listed below that fail in materials or workmanship within specified warranty period, when such goods are properly installed, operated, and maintained in accordance with product documentation.

1. Covered Products Include:
   a. Heating cables, connection kits, and accessories.
   b. Thermostats, controllers, panels, contactors, sensors, and accessories.
2. Warranty Period: Two years from date of Substantial Completion.

B. Manufacturer's Extended Warranty: Provide Owner an extended product warranty for heat-tracing products described below.

1. Contractor must complete and forward to Owner the Installation, Inspection, or Commissioning Record(s), and complete manufacturer’s online warranty registration form within 30 days from date of installation, otherwise only standard limited warranty applies.
2. Heating Cable Warranty Period: 10 years from date of Substantial Completion.
3. Heating cables, connection kits and accessories not automatically offered with a 10-year manufacturer's warranty, as a standard matter of course, will not be allowed. Warranty information must be published on the manufacturer's website.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Complete pipe freeze protection system for insulated pipes exposed to the risk of freezing. System consists of a self-regulating heating cable, connection kits, accessories, and energy-efficient control and monitoring controller. The heating cable shall have a polyolefin jacket for aboveground fire sprinkler piping, including standpipes, mains, and branch fire sprinkler piping,

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage manufacturer to design complete and functional heat-tracing system as required by Project documents.

2.3 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide RAYCHEM, a brand of nVent; XL-Trace Pipe Freeze/Flow Maintenance or comparable product by one of the following:

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1. DELTA THERM .

B. Source Limitations: Obtain heat-tracing components and controllers from single manufacturer. To ensure system integrity and meet warranty requirements, only components and controllers supplied by cable manufacturer are to be used.

C. Comply with UL 515A, CSA 22.2 No 130-16, and IEEE 515.1 requirements.

D. Heating Element: Pair of parallel No. 16 AWG, nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end with a watertight end seal. Cable shall be capable of crossing over itself once without overheating.

E. Electrical Insulating Jacket: Flame-retardant modified polyolefin.

F. Ground Braid: Tinned-copper braid. Minimum 70 percent for ground path and mechanical ruggedness.

G. Outer Jacket: Modified polyolefin with ultraviolet inhibitor**.** Outer jacket to be printed with cable model number, agency listings, batch number, and meter marks (for ease of installation within maximum circuit length).

H. Maximum Operating Temperature (Power On): 150 deg F.

I. Maximum Exposure Temperature (Power Off): 150 deg F.

J. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

K. Capacities and Characteristics:

1. Maximum Heat Output at 50 deg F: 8 W/ft. .
2. Piping Diameter: 4" .
3. Electrical Characteristics for Single-Circuit Connection:
   a. Volts: 208 .
   b. Phase: Single.

2.4 HEATING CABLE CONNECTION KITS

A. Basis-of-Design Product: RAYCHEM; RayClic.

B. Provide power connections, splices/tees, and end seal kits to properly connect and terminate heating cable circuit along specified length of piping.

C. Install splices, tees, and crosses underneath pipe insulation with service loops installed to allow for future service of piping.

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D. Connection kits shall be rated NEMA 4X to prevent water ingress and corrosion. All components shall be UV stabilized and shall not require cutting into heating-cable core to expose bus wires.

E. Certification: UL Listed, CSA Certified, and FM approved.

F. Locate connection kits above grade for buried applications.

2.5 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, cable ties, connection kits, and end seals all furnished by manufacturer or as recommended in writing by manufacturer.

B. Identification: Provide and install "Electric Heat Traced" labels on exterior of pipe insulation every 10 ft. on opposite sides of pipe, and on all splices, tees, crosses, and power connections for the entire length of heat traced piping.

C. Thermal Pipe Insulation:

1. Pipes to be thermally insulated in accordance with manufacturer's written requirements.
2. Thermal Insulation: Flame retardant, fiberglass with waterproof covering.

2.6 SYSTEM APPROVAL

A. Complete heat trace system (heating cable, connection kits, and controller) shall be listed by a Nationally Recognized Testing Laboratory (NRTL), and marked for intended freeze protection of standpipes, mains, and branch fire sprinkler piping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Prior to installation of heating cable system, verify that all piping, to be heat traced has passed all hydrostatic/pressure test and is signed off by plumbing inspector.
2. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.

B. Preinstallation Testing:

1. Prior to installation of heating cable on piping, an insulation resistance test shall be performed by installing contractor to ensure integrity of heating cable as describe in installation and maintenance manual.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

A. Protect all heating cable ends from moisture ingress until cable is terminated with end seals.

1. Basis-of-Design Product: RAYCHEM; RayClic-E end seals.

3.3 INSTALLATION

A. Install electric heating cable where indicated and in accordance with NFPA 70 and NFPA 13.

B. All heat-tracing components including power connections, splices, tees, and crosses or end seal, must be installed above grade and protected from abuse or damage. In accordance with NEC and CEC, electrical connections are not permitted to be installed below grade.

C. In the field, all heating cables shall be meggered with a minimum of 2,500 V dc for self-regulating cable. The following field megger readings shall be taken on each heating cable:

1. Heating cable shall be meggered when received at Project site before installation.
2. Heating cable shall be meggered after installation, but before insulation is installed.
3. Heating cable shall be meggered after insulation is installed.
4. Heating cable shall be meggered at final commissioning prior to being energized.
5. Insulation resistance must exceed 1.000 megohms at 2,500 V dc.
6. All results must meet manufacturer's specification.

D. Install electric heating cables after piping has passed all hydrostatic pressure testing and before insulation is installed.

E. Install electric heating cables in accordance with IEEE 515.1.

F. Install insulation over piping with electric cables in accordance with Section 210700 "Fire-Suppression Systems Insulation."

G. Install warning tape on piping insulation where piping is equipped with electric heating cables.

H. Set field-adjustable switches and circuit-breaker trip ranges.

3.4 CONNECTIONS

A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Initial start-up and field testing (commissioning) of system shall be performed by factory technician in accordance with Owner's requirements.

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1. System shall be commissioned in accordance with manufacturer's installation and operation manual.
2. Field Visits to be scheduled at the following intervals:
   a. Preinstallation training.
   b. Final electrical insulation resistance (megger) testing of heating cable after insulation has been installed.
   c. Final commissioning including controller programming (if applicable).
3. Technician to verify:
   a. Controller parameters are set to the application requirements.
   b. Controller alarm contacts are properly connected to the BMS, as applicable.

B. Contractor to perform the following tests and inspections during installation:

1. Heating cable shall be meggered when received at Project site before installation.
2. Heating cable shall be meggered after installation, but before insulation is installed.
3. Heating cable shall be meggered after insulation is installed.
   a. Insulation resistance must exceed 1,000 megohms at 2,500 V dc.
4. All results must meet manufacturer's specification.
5. Test cables for electrical continuity during installation.
6. Test insulation integrity before energizing.
7. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

C. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

D. Cables will be considered defective if they do not pass tests and inspections in accordance with manufacturer's testing requirements.

E. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed heating cables, including nonheating leads, from damage and moisture ingress during construction.

B. Remove and replace damaged heat-tracing cables.

END OF SECTION 210533

SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through floor into the building and the following:

1. Pipes, fittings, and specialties.
2. Fire-suppression specialty valves.
3. Protective enclosures.
4. Alarm devices.

B. Related Requirements:

1. Section 211119 "Fire-Department Connections" for exposed-, flush-, and yard-type, fire-department connections.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying the water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with FM Global's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.

C. Grooved-End, Ductile-Iron Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International.
   b. Tyco by Johnson Controls Company.
   c. Victaulic Company.
2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

D. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

E. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.

1. Gaskets: AWWA C111, rubber.

F. Flanges: ASME B16.1, Class 125, cast iron.

2.2 PVC PIPE AND FITTINGS

A. PVC Pipe: AWWA C900 or , Class 200, with bell end with gasket, and with spigot end.

B. PVC Fittings: AWWA C900 or , Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

2.3 JOINING MATERIALS

A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.

2.4 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.5 BACKFLOW PREVENTERS

A. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Ames Fire & Waterworks; A WATTS Brand.
   b. FEBCO; A WATTS Brand.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1015 or AWWA C510.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

B. Double-Check, Detector-Assembly Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Ames Fire & Waterworks; A WATTS Brand.
   b. FEBCO; A WATTS Brand.
   c. Mueller Co.
2. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or FM Global's "Approval Guide."
3. Operation: Continuous-pressure applications.
4. End Connections: Flanged.
5. Accessories:
   a. Valves: UL 262 and FM Global's "Approval Guide" listing; OS&Y gate type with flanged ends on inlet and outlet.
   b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

2.6 ALARM DEVICES

A. General: UL 753 and FM Global's "Approval Guide" listing, of types and sizes to mate and match piping and equipment.

B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig working pressure; designed for horizontal or vertical installation; with two single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.

C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Water-Main Connection: Arrange with water utility company for tap of size and in location indicated in water main.

B. Comply with NFPA 24 for fire-service-main piping materials and installation.

C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

1. Install encasement for piping according to ASTM A 674 or AWWA C105.

D. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

E. Bury piping with depth of cover over top at least 48 , with top at least 12 inches below level of maximum frost penetration, and according to the following:

1. Under Driveways: With at least 36 inches of cover over top.
2. In Loose Gravelly Soil and Rock: With at least 12 inches of additional cover.

F. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

G. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.

1. Terminate fire-suppression water-service piping within the building at the floor slab until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.

H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

I. Comply with requirements in Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

J. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

K. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in tubing NPS 2 and smaller.

C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of tubes and remove burrs.

E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

F. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

G. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.

H. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

I. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139.

J. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

K. Do not use flanges or unions for underground piping.

3.4 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.
6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL-Listed or FM Global-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL-Listed or FM Global-Approved Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. Install full-size valved bypass.

H. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers in Section 033000 "Cast-in-Place Concrete."

3.6 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support 2-1/2 NPS and larger backflow preventers and piping on concrete piers. Comply with requirements for concrete piers in Section 033000 "Cast-in-Place Concrete."

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install ball drip valves at each check valve for fire-department connection to mains.

B. Install protective pipe bollards on three sides of each freestanding fire-department connection. Pipe bollards are specified in Section 055000 "Metal Fabrications."

3.8 ALARM DEVICE INSTALLATION

A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.

B. Supervisory Switches: Supervise valves in open position.

1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.

C. Locking and Sealing: Secure unsupervised valves as follows:

1. Valves: Install chain and padlock on open OS&Y gate valve.
2. Post Indicators: Install padlock on wrench on indicator post.

D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.

E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.

F. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Section 284621.13 "Conventional Fire-Alarm Systems."

3.9 CONNECTIONS

A. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.10 FIELD QUALITY CONTROL

A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure or a minimum of 200 psi. for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to zero psig . Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare test and inspection reports.

3.11 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel. Comply with requirements for identifying devices in Section 220553 "Identification for Plumbing Piping and Equipment."

3.12 PIPING SCHEDULE

A. Underground fire-suppression water-service piping NPS 6 to NPS 12 shall be one of the following:

1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and gasketed joints.
3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and gasketed joints.
4. PVC, Class 200 pipe listed for fire-protection service; PVC fittings of same class as pipe; and gasketed joints.

3.13 VALVE SCHEDULE

END OF SECTION 211100

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Specialty valves.
4. Sprinklers.
5. Manual control stations.
6. Pressure gauges.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Design Data:

1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
   a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13 NFPA 13R.

C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

D. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Sprinkler system design shall be approved by authorities having jurisdiction.
   a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
   b. Sprinkler Occupancy Hazard Classifications:
      1) Building Service Areas: Ordinary Hazard, Group 1 .
      2) Electrical Equipment Rooms: Ordinary Hazard, Group 1 .
      3) General Storage Areas: Ordinary Hazard, Group 1 .
      4) Mechanical Equipment Rooms: Ordinary Hazard, Group 1 .
      5) Office and Public Areas: Light Hazard .
      6) Residential Living Areas: Light Hazard .
2. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Residential (Dwelling) Occupancy: 0.05 gpm over 400-sq. ft. area.
   b. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
   c. Ordinary-Hazard, Group 1 Occupancy: area.
   d. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
3. Maximum protection area per sprinkler according to UL listing.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Galvanized- and Black- Steel Pipe: ASTM A53/A53M, Type E , Grade B . Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Galvanized- and Black- Steel Pipe: ASTM A135/A135M; ASTM A795/A795M, Type E ; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Thinwall Galvanized- and Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

D. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

E. Nonstandard OD, Thinwall Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M thinwall with plain ends and wall thickness less than Schedule 10.

F. Hybrid Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5.

G. Schedule 5 Steel Pipe: ASTM A135/A135M or ASTM A795/A795M lightwall with plain ends.

H. Galvanized- and Black-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.

I. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

J. Cast-Iron Flanges: ASME 16.1, Class 125.

K. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
   a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
   b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

L. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International.
   b. Tyco by Johnson Controls Company.
   c. Victaulic Company.
2. Pressure Rating: 250-psig minimum.
3. Galvanized Painted Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 CPVC PIPE AND FITTINGS

A. CPVC Pipe: ASTM F442/F442M and UL 1821, SDR 13.5, for 175-psig rated pressure at 150 deg F, with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.

B. CPVC Fittings: UL listed or FM Global approved, for 175-psig rated pressure at 150 deg F, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.

1. NPS 3/4 to NPS 1-1/2: ASTM F438 and UL 1821, Schedule 40, socket type.
2. NPS 2 to NPS 3: ASTM F439 and UL 1821, Schedule 80, socket type.
3. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
4. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.

C. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493 solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.

D. Plastic Pipe-Flange Gasket and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 COVER SYSTEM FOR SPRINKLER PIPING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. DecoShield Systems, Inc.

B. Description: System of support brackets and covers made to protect sprinkler piping.

C. Brackets: Glass-reinforced nylon.

D. Covers: Extruded-PVC sections of length, shape, and size required for size and routing of CPVC piping.

2.5 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Specialty Valves Pressure Rating: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Tyco by Johnson Controls Company.
   b. Victaulic Company.
   c. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.

G. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Reliable Automatic Sprinkler Co., Inc. (The).
   b. Tyco by Johnson Controls Company.
2. Standard: UL 1726.
3. Pressure Rating: 175-psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.6 AIR VENT

A. Manual Air Vent/Valve:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AGF Manufacturing, Inc.
   b. Shurjoint; a part of Aalberts Integrated piping Systems.
   c. Victaulic Company.
2. Description: Ball valve that requires human intervention to vent air.
3. Body: Forged brass.
4. Ends: Threaded.
5. Minimize Size: 1/2 inch.
6. Minimum Water Working Pressure Rating: 300 psig.

B. Automatic Air Vent:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AGF Manufacturing, Inc.
   b. CLA-VAL.
   c. Engineered Corrosion Solutions.
2. Description: Automatic air vent that automatically vents trapped air without human intervention.
3. Standard: UL listed or FM Global approved for wet-pipe fire sprinkler systems.
4. Vents oxygen continuously from system.

5. Float valve to prevent water discharge.
6. Minimum Water Working Pressure Rating: 175 psig.

2.7 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International.
   b. Tyco by Johnson Controls Company.
   c. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175-psig minimum .
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Reliable Automatic Sprinkler Co., Inc. (The).
   b. Tyco by Johnson Controls Company.
   c. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum .
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AGF Manufacturing, Inc.
   b. Potter Electric Signal Company, LLC.
   c. Potter Roemer LLC; a Division of Morris Group International.
2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.

7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Tyco by Johnson Controls Company.
   b. Victaulic Company.
   c. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 300 psig.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aegis Technologies, Inc.
   b. CPS Products, Inc.
   c. Merit Manufacturing.
2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum .
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. ALEUM USA.
   b. FlexHead Industries, Inc.
   c. Victaulic Company.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum .
5. Size: Same as connected piping, for sprinkler.

2.8 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Reliable Automatic Sprinkler Co., Inc. (The).
2. Tyco by Johnson Controls Company.
3. Victaulic Company.
4. Viking Corporation.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Residential Sprinklers: 175-psig maximum.

D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

E. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767 .
2. Nonresidential Applications: UL 199 .
3. Residential Applications: UL 1626 .
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

F. Sprinkler Finishes: Chrome plated bronze .

G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment .
2. Sidewall Mounting: Chrome-plated steel , one piece, flat.

H. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Reliable Automatic Sprinkler Co., Inc. (The).
   b. Tyco by Johnson Controls Company.
   c. Victaulic Company.
   d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.9 MANUAL CONTROL STATIONS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.

B. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.10 PRESSURE GAUGES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AGF Manufacturing, Inc.
2. AMETEK, Inc.
3. Ashcroft Inc.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gauge Range: 0- to 250-psig minimum .

E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping."

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

L. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.

M. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices .

N. Fill sprinkler system piping with water.

O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

N. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.

3.4 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

E. Air Vent:

1. Provide at least one air vent in each wet pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
2. Provide dielectric union for dissimilar metals, ball or globe valve, and strainer upstream of automatic air vent.
3. Pipe from outlet of air vent to drain.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.10 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. CPVC pipe, Schedule 40 Schedule 80 CPVC fittings, and solvent-cemented joints may be used for light-hazard and residential occupancies.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller , shall be one of the following:

1. Standard-weight , black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. , galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. , black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
4. , galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.

5. Standard-weight , black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
6. , galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
8. black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 , shall be one of the following:

1. Standard-weight , black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. , galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. , black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Standard-weight , galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

F. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger , shall be the following:

1. Standard-weight , black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. , galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Standard-weight , black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. , galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers .
2. Rooms with Suspended Ceilings: Pendent sprinklers Recessed sprinklers .
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated .
5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated .

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Residential Sprinklers: Dull chrome.
5. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Grout.
3. Silicone sealants.

1.2 ACTION SUBMITTALS

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. GE Construction Sealants; Momentive Performance Materials Inc.
   b. Sherwin-Williams Company (The).
   c. The Dow Chemical Company.
2. Verify sealant has a VOC content of 250 g/L or less.
3. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at

pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
   a. Piping Smaller Than NPS 6 : Steel pipe sleeves .
2. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6 : Steel pipe sleeves with sleeve-seal system .
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6 : Steel pipe sleeves .
4. Interior Partitions:
   a. Piping Smaller Than NPS 6 : Steel pipe sleeves .

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.2 ACTION SUBMITTALS

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. BrassCraft Manufacturing Co.; a Masco company.
2. Dearborn Brass.
3. Jones Stephens Corp.
4. Keeney Manufacturing Company (The).
5. Mid-America Fittings, Inc.
6. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
   b. Chrome-Plated Piping: One-piece steel or split-casting brass with polished, chrome-plated finish.
   c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
   d. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
   f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
   g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
   h. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping : Split floor plate.

END OF SECTION 220518

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder-joint connections.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Handlever: For quarter-turn valves smaller than NPS 4 .

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, One-Piece:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo.
   b. Crane.
   c. Jomar.
   d. KITZ Corporation.
2. Description:
   a. Standard: MSS SP-110.
   b. CWP Rating: 400 psig.
   c. Body Design: One piece.
   d. Body Material: Forged brass or bronze.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass or stainless steel.
   h. Ball: Chrome-plated brass or stainless steel.
   i. Port: Reduced.

B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Crane; a Crane brand.
   c. Jomar Valve.
   d. NIBCO INC.
   e. WATTS.
2. Description:
   a. Standard: MSS SP-110 or MSS SP-145.
   b. CWP Rating: 600 psig.
   c. Body Design: Two piece.
   d. Body Material: Forged brass.
   e. Ends: Threaded and soldered.
   f. Seats: PTFE.
   g. Stem: Brass.
   h. Ball: Chrome-plated brass.
   i. Port: Full.

C. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.

b. Crane; a Crane Co. brand.
c. Jomar Valve.
d. KITZ Corporation.
e. NIBCO INC.

2. Description:
a. Standard: MSS SP-110 or MSS SP-145.
b. CWP Rating: Minimum 200 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Press.
f. Press Ends Connection Rating: Minimum 200 psig.
g. Seats: PTFE or RPTFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.
k. O-Ring: Buna-N or EPDM.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, One-Piece:

1. Manufacturers: Subject to compliance with requirements, undefined:
a. Apollo Flow Controls; Conbraco Industries, Inc.
b. FNW; Ferguson Enterprises, Inc.
c. NIBCO INC.
d. WATTS.

2. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 400 psig.
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, undefined:
a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. WATTS.
e. Zurn Industries, LLC.

2. Description:
a. Standard: MSS SP-110 or MSS-145.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.

d. Body Material: Bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

C. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Crane; a Crane brand.
   c. NIBCO INC.
   d. WATTS.
   e. Zurn Industries, LLC.
2. Description:
   a. Standard: MSS SP-110 or MSS-145.
   b. CWP Rating: Minimum 200 psig.
   c. Body Design: Two piece.
   d. Body Material: Bronze.
   e. Ends: Press.
   f. Press Ends Connections Rating: Minimum 200 psig.
   g. Seats: PTFE or RTPFE.
   h. Stem: Bronze or brass.
   i. Ball: Chrome-plated brass.
   j. Port: Full.
   k. O-Ring Seal: EPDM or Buna-N.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3.3 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valves, one piece.
3. Bronze ball valve, one piece with bronze trim.
4. Brass ball valves, two-piece with full port and brass trim.
5. Bronze ball valves, two-piece with full port and bronze or brass trim.

3.4 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valve, one piece.
3. Bronze ball valve with bronze trim, one piece.
4. Brass ball valves, two-piece with full port and brass trim.
5. Bronze ball valves, two-piece with full port and bronze or brass trim.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Brass ball valve, one piece. Provide with threaded or solder-joint ends.
2. Bronze ball valve, one piece with bronze trim. Provide with threaded or solder-joint ends.
3. Brass ball valves, two-piece with full port and brass trim. Provide with threaded solder or press connection-joint ends.
4. Bronze ball valves, two-piece with full port and bronze or brass trim. Provide with threaded solder or press-connection-joint ends.

END OF SECTION 220523.12

SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze swing check valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. WATTS.
2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Jenkins Valves; a Crane brand.
   c. NIBCO INC.
   d. WATTS.
   e. Zurn.
2. Description:
   a. Standard: MSS SP-80, Type 4.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: PTFE.

C. Bronze Swing Check Valves, Press Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. Watts.
2. Description:
   a. Standard: MSS SP-80 and MSS SP-139.
   b. CWP Rating: Minimum 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 584, bronze.
   e. Ends: Press.
   f. Press Ends Connection Rating: Minimum 200 psig
   g. Disc: Brass or bronze.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered or press-ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
3. For Copper Tubing, NPS 5 and Larger: Flanged.
4. For Steel Piping, NPS 2 and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded.
6. For Steel Piping, NPS 5 and Larger: Flanged.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze swing check valves nonmetallic disc, Class 125, with threaded end connections.

END OF SECTION 220523.14

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Pipe-positioning systems.
6. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

1.2 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7 .

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel .

B. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel .

2.3 TRAPEZE PIPE HANGERS

2.4 THERMAL HANGER-SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 MATERIALS

A. Aluminum: ASTM B 221.

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Install lateral bracing with pipe hangers and supports to prevent swaying.

E. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

G. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

3.6 PAINTING

A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
13. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
14. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
15. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
16. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
17. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
18. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
19. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
3. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
4. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
5. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
6. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Storm-water piping exposed to freezing conditions.
4. Roof drains and rainwater leaders.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

A. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA.
   b. Armacell LLC.
   c. K-Flex USA.

G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Owens Corning.
2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ .
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
   c. Mon-Eco Industries, Inc.
2. Verify adhesives have a VOC content of 80 g/L or less.
3. Verify adhesives and sealants comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Speedline Corporation.
   c. The Dow Chemical Company.
2. Adhesive: As recommended by Adhesive - PVC Jacket manufacturer and with a VOC content of 50 g/L or less.
3. Verify adhesives and sealants comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Foster Brand; H. B. Fuller Construction Products.
   b. Mon-Eco Industries, Inc.
   c. Owens Corning.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 58 to plus 176 deg F .
4. Color: White or gray.
5. Verify sealant has a VOC content of 420 g/L or less.
6. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
   c. Mon-Eco Industries, Inc.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. Verify sealant has a VOC content of 420 g/L or less.
6. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. Verify sealant has a VOC content of 420 g/L or less.
6. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. P.I.C. Plastics, Inc.
   c. Speedline Corporation.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White .
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. 3M Industrial Adhesives and Tapes Division.
   b. Ideal Tape Co., Inc., an American Biltrite Company.
   c. Knauf Insulation.
2. Width: 3 inches .
3. Thickness: 11.5 mils .
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the contract documents.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.3 PENETRATIONS

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
   a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1/2 inch thick.
   b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be the following:
   a. Flexible Elastomeric: 1/2 inch thick.
   b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. PVC : 20 mils thick.

D. Piping, Exposed:

1. PVC : 20 mils thick.

END OF SECTION 220719

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service fire-service mains .

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

F. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping.

2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.6 PROJECT CONDITIONS

1.7 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type L , water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

B. Hard Copper Tube: ASTM B 88, Type L , water tube, drawn temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

C. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

E. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Anvil International.
      2) Smith-Cooper International.

3) Victaulic Company.

F. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 150 and Class 200.

1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

G. PVC, AWWA Pipe: AWWA C900, Class 150 and Class 200, with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.
2. PVC Fabricated Fittings: AWWA C900, Class 150 and Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   a. Gaskets: AWWA C111, rubber.
5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.2 JOINING MATERIALS

A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.3 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. FEBCO; A WATTS Brand.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1013 .
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
   b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 3/4 to NPS 3 shall be soft copper tube, ASTM B 88, Type L ; wrought-copper, solder-joint fittings; and brazed joints.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.4 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.

2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

E. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

G. Install PE pipe according to ASTM D 2774 and ASTM F 645.

H. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

I. Bury piping with depth of cover over top at least 48 inches , with top at least 12 inches below level of maximum frost penetration.

J. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

K. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

L. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

M. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for hangers, supports, and anchor devices specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

D. Install hangers for copper tubing with maximum spacing and minimum rod diameters to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting and coupling.

F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 JOINT CONSTRUCTION

A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
4. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
5. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
6. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.7 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.

2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.
6. Pipe clamps and tie rods.
7. .

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
3. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

C. MSS Valves: Install as component of connected piping system.

D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.9 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

B. Water Meters: Install displacement-type water meters, NPS 2 and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.

C. Water Meters: Install compound-type water meters, NPS 3 and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.10 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.11 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig . Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.12 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.13 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
   a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.

b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. PEX tube and fittings.
3. Transition fittings.
4. Dielectric fittings.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

1.4 WARRANTY

A. Polypropylene Piping (PP-R) Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.

1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.
2. Warranty is to be in effect only upon submission by the Contractor to the manufacturer of valid pressure/leak documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B88, Type L .

B. Annealed-Temper Copper Tube: ASTM B88, Type L .

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Wrought Copper Unions: ASME B16.22.

G. Copper Tube, Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. NIBCO INC.
   c. Viega LLC.
2. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end.
3. Minimum 200-psig working-pressure rating at 250 deg F.

2.3 PEX TUBE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. REHAU.
2. Sioux Chief Manufacturing Company, Inc.
3. Uponor.
4. Viega LLC.
5. Zurn Industries, LLC.

B. Tube Material: PEX plastic according to ASTM F876 and ASTM F877.

C. Fittings: ASTM F1807, metal insert and copper crimp rings ASTM F1960, cold expansion fittings and reinforcing rings.

D. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F876; with plastic or corrosion-resistant-metal valve for each outlet.

2.4 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. WATTS.
   b. Wilkins.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F .
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. WATTS.
   b. Wilkins.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F .
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Grinnell G-Fire by Johnson Controls Company.
   b. Sioux Chief Manufacturing Company, Inc.

c. Victaulic Company.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F .
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller , shall be one of the following:

1. Soft copper tube, ASTM B88, Type L ; wrought-copper, solder-joint fittings; and brazed copper pressure-seal fittings; and pressure-sealed joints.

D. Aboveground domestic water piping, NPS 2 and smaller , shall be one of the following:

1. Hard copper tube, ASTM B88, Type L ; cast- or wrought-copper, solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B88, Type L ; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B88, Type L ; copper push-on-joint fittings; and push-on joints.
4. PEX tube, NPS 1 and smaller.
   a. Fittings for PEX tube:
      1) ASTM F1807, metal insert and copper crimp rings.
      2) ASTM F1960, cold expansion fittings and reinforcing rings.
      3) ASSE 1061, push-fit fittings.

E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 , shall be one of the following:

1. Hard copper tube, ASTM B88, Type L ; cast- or wrought-copper, solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B88, Type L ; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B88, Type L ; grooved-joint, copper-tube appurtenances; and grooved joints.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install valves according to the following:

1. Section 220523.12 "Ball Valves for Plumbing Piping."
2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
3. Section 220523.14 "Check Valves for Plumbing Piping."
4. Section 220523.15 "Gate Valves for Plumbing Piping."

D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

E. Install domestic water piping level and plumb.

F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Install piping to permit valve servicing.

K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install PEX tubing with loop at each change of direction of more than 90 degrees.

O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

P. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220519 "Meters and Gages for Plumbing Piping."

Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

R. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.

I. Joints for PEX Tubing, ASTM: Join according to ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.

J. Joints for PEX Tubing, ASSE: Join according to ASSE 1061 for push-fit fittings.

K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings .

3.6 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 : Use dielectric flanges .

3.7 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for copper tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install vinyl-coated hangers for PEX tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping within 12 inches of each fitting.

E. Support vertical runs of copper to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support vertical runs of PEX tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:
   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
   c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
   a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
   c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
   f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Repeat procedures if biological examination shows contamination.

e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers for domestic water piping.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer device.

B. Related Requirements:

1. Section 211100 "Facility Fire-Suppression Water-Service Piping" for fire water-service backflow prevention devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze Chrome plated.

B. Hose-Connection Vacuum Breakers :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. WATTS.
   b. Woodford Manufacturing Company.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated .

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. FEBCO; A WATTS Brand.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Body: Bronze cast silicon copper alloy or stainless steel for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.

8. Accessories:
   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
   c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, Backflow-Prevention Assemblies :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. FEBCO; A WATTS Brand.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Body: Bronze cast silicon copper alloy or stainless steel for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:
   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller; bronze cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded or solder for NPS 2 and smaller; flanged or solder for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. Memory-Stop Balancing Valves :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   b. Crane; a Crane Co. brand.
   c. NIBCO INC.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass or stainless steel.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Leonard Valve Company.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F .
9. Valve Finish: Chrome plated .

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Titan Flow Control, Inc.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.

4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Drain: Pipe plug Factory-installed, hose-end drain valve.

2.9 HOSE BIBBS

A. Hose Bibbs :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Woodford Manufacturing Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle Operating key.
14. Operation for Finished Rooms: Wheel handle Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Nonfreeze Vacuum Breaker Wall Hydrants :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. WATTS.
   b. Woodford Manufacturing Company.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1019, Type A or Type B.
3. Type: Automatic draining with integral air-inlet valve.
4. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig.
6. Operation: Loose key .
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.

8. Inlet: NPS 1/2 or NPS 3/4.
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves :

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Sioux Chief Manufacturing Company, Inc.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows Piston Diaphragm.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Sioux Chief Manufacturing Company, Inc.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.

7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. MIFAB, Inc.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

C. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Y-Pattern Strainers: For water, install on supply side of each water pressure-reducing valve and pump.

F. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

G. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

H. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Wall hydrants.
7. Trap-seal primer device.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

D. Adjust each reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

END OF SECTION 221119

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonpressure-type transition couplings.
2. Pressure-type pipe couplings.
3. Expansion joints and deflection fittings.
4. Backwater valves.
5. Cleanouts.
6. Concrete.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fernco Inc.
   b. Mission Rubber Company, LLC; a division of MCP Industries.
   c. NDS Inc.

D. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fernco Inc.
   b. Logan Clay Pipe.
   c. Mission Rubber Company, LLC; a division of MCP Industries.

E. Nonpressure-Type, Rigid Couplings:

1. Description: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. ANACO-Husky.

2.3 BACKWATER VALVES

A. Cast-Iron Backwater Valves:

1. Description: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.
2. <Click here to find, evaluate, and insert list of manufacturers and products.>
3. Horizontal type; with swing check valve and hub-and-spigot ends.
4. Combination horizontal and manual gate-valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.
5. Terminal type; with bronze seat, swing check valve, and hub inlet.

B. PVC Backwater Valves:

1. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.
2. <Click here to find, evaluate, and insert list of manufacturers and products.>

2.4 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
3. Top-Loading Classification(s): Medium Duty Heavy Duty and Extra-Heavy Duty.
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.5 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350, and the following:

1. Cement: ASTM C 150/C 150M, Type II.
2. Fine Aggregate: ASTM C 33/C 33M, sand.
3. Coarse Aggregate: ASTM C 33/C 33M, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A 1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

E. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 36-inch minimum cover.
4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.

F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
4. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
5. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. Unshielded flexible or rigidcouplings for pipes of same or slightly different OD.

b. Unshielded, increaser/reducer-pattern, flexible or rigidcouplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.5 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping manholes or pits.

B. Install combination horizontal and manual gate-type valves in piping and in manholes.

C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
2. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
3. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads .

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
   a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
   b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

C. Connect to oil and sand interceptors specified in Section 221323 "Sanitary Waste Interceptors."

3.8 IDENTIFICATION

A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

END OF SECTION 221313

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. ABS pipe and fittings.
3. PVC pipe and fittings.
4. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water .

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. Tyler Pipe; a part of McWane family of companies.

B. Pipe and Fittings: ASTM A 74, Service class.

C. Gaskets: ASTM C 564, rubber.

D. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 ABS PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

C. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

D. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

E. Solvent Cement: ASTM D 2235.

2.5 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F 656.

F. Solvent Cement: ASTM D 2564.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Unshielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dallas Specialty & Mfg. Co.
      2) Fernco Inc.
      3) Mission Rubber Company, LLC; a division of MCP Industries.
   b. Standard: ASTM C 1173.
   c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. End Connections: Same size as and compatible with pipes to be joined.
   e. Sleeve Materials:
      1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
3. Shielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Cascade Waterworks Mfg. Co.
      2) Mission Rubber Company, LLC; a division of MCP Industries.
   b. Standard: ASTM C 1460.
   c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    a. Straight tees, elbows, and crosses may be used on vent lines.
3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

O. Install aboveground ABS piping according to ASTM D 2661.

P. Install aboveground PVC piping according to ASTM D 2665.

Q. Install underground ABS and PVC piping according to ASTM D 2321.

R. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping.
   a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
   a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary waste gravity-flow piping.
   a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Unshielded Shielded, nonpressure transition couplings.

3.5 VALVE INSTALLATION

A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.

B. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install hangers for ABS and PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

E. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support vertical runs of ABS and PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves in pit with pit cover flush with floor .
6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect waste piping as indicated.
   a. Provide shutoff valve if indicated and union for each connection.
   b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
3. Solid-wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
3. Solid-wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

E. Underground, soil and waste piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
2. Section 077200 "Roof Accessories" for preformed flashings.
3. Section 078413 "Penetration Firestopping" for through-penetration firestop assemblies.
4. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
5. Section 334200 "Stormwater Conveyance" for storm drainage piping and piping specialties outside the building.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves Where indicated on Drawings :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: Hub and spigot or hubless .
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed .
8. Extension: ASTM A74, Service Class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Horizontal, Plastic Backwater Valves Where indicated on Drawings :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. IPS Corporation.
   b. Sioux Chief Manufacturing Company, Inc.
   c. Zurn Industries, LLC.
2. Size: Same as connected piping.
3. Body: ABS PVC.
4. Cover: Same material as body with threaded access to check valve.
5. Check Valve: Removable swing check.
6. End Connections: Socket type.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk , brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required .
7. Outlet Connection: Inside calk Spigot Threaded.
8. Closure: Brass plug with tapered threads .
9. Adjustable Housing Material: Cast iron with threads setscrews or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy .
11. Frame and Cover Shape: Round .
12. Top-Loading Classification: Heavy Medium Duty.
13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
   a. Brass .
   b. Countersunk or raised head.
   c. Drilled and threaded for cover attachment screw.
   d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
7. Wall Access, Frame and Cover: Round , nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps :

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings :

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Floor-Drain, Inline Trap Seal :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. RectorSeal Plumbing; A CSW Industrials Company.
2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
3. Material: Polymer.
4. Standard: Tested and certified in accordance with ASSE 1072.
5. Listing: ICC-ES or IAPMO listed.
6. Size: Same as floor drain outlet or strainer throat.

D. Air-Gap Fittings :

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device :

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings :

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Assemble open drain fittings and install with top of hub 1 inch above floor.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

J. Install vent caps on each vent pipe passing through roof.

K. Install wood-blocking reinforcement for wall-mounting-type specialties.

L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221319.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor drains.
2. Floor sinks.

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

F. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Sioux Chief Manufacturing Company, Inc.
c. Zurn Industries, LLC.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron .
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Not required .
8. Outlet: Bottom .
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel .
11. Sediment Bucket: Not required .
12. Top or Strainer Material: Nickel bronze .
13. Top of Body and Strainer Finish: Nickel bronze .
14. Top Shape: Round .

B. Plastic Floor Drains :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Sioux Chief Manufacturing Company, Inc.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.6.3.
3. Material: ABS or PVC .
4. Seepage Flange: Not required .
5. Clamping Device: Not required .
6. Outlet: Bottom .
7. Sediment Bucket: Not required .
8. Top or Strainer Material: Bronze .
9. Top of Body and Strainer Finish: Nickel bronze .
10. Top Shape: Round .

2.3 FLOOR SINKS

A. Plastic Floor Sinks :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. IPS Corporation.
   b. Oatey.
   c. Sioux Chief Manufacturing Company, Inc.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: PVC.
5. Outlet: Bottom, PVC primer and solvent cement, connection.
6. Sediment Bucket: Not required .

7. Internal Strainer: Not required .
8. Internal Strainer Material: PVC .
9. Top Grate Material: PVC .
10. Top Shape: Square .
11. Top Loading Classification: No traffic .
12. Funnel: Not required . .
13. .

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
   a. Maintain integrity of waterproof membranes where penetrated.
5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

D. Install piping adjacent to equipment to allow service and maintenance.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Residential, electric, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 Retain "Seismic Qualification Data" Paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." See ASCE/SEI 7 for certification requirements for equipment and components.

1.5 CLOSEOUT SUBMITTALS

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Periods: From date of Substantial Completion.
   a. Residential, Electric, Storage, Domestic-Water Heaters:
      1) Storage Tank: Six years.
      2) Controls and Other Components: 6 years.
   b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 RESIDENTIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Residential, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. A. O. Smith Corporation.
   b. Bradford White Corporation.
   c. Rheem Manufacturing Company.
2. Standard: UL 174.
3. Storage-Tank Construction: Steel.
   a. Tappings: ASME B1.20.1 pipe thread.
   b. Pressure Rating: 150 psig.
   c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed, Storage-Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
   c. Drain Valve: Corrosion-resistant metal with hose-end connection.
   d. Insulation: Comply with ASHRAE/IES 90.1 .
   e. Jacket: Steel, cylindrical, with enameled finish or high-impact composite material.
   f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
   g. Heating Elements: Electric, screw-in immersion type.
   h. Temperature Control: Adjustable thermostat.
   i. Safety Control: High-temperature-limit cutoff device or system.
   j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. A. O. Smith Corporation.
   b. AMTROL, Inc.
   c. Taco Comfort Solutions.
2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:
   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
   a. Working-Pressure Rating: 150 psig .
   b. Capacity Acceptable: 2 gal. minimum.
   c. Air Precharge Pressure: 50 psi .

B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.

C. Heat-Trap Fittings: ASHRAE/IES 90.1 .

D. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Residential, Electric, Domestic-Water Heater Mounting: Install residential, electric, domestic-water heaters on floor .

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

C. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill electric, domestic-water heaters with water.

J. Charge domestic-water expansion tanks with air to required system pressure.

K. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

L. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.2 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

END OF SECTION 223300

SECTION 224100 - RESIDENTIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bathtubs.
2. Bathtub faucets.
3. Lavatories.
4. Lavatory faucets.
5. Showers.
6. Shower faucets.
7. Kitchen sinks.
8. Laundry trays
9. Sink faucets.
10. Disposers.
11. Water closets.
12. Toilet seats.
13. Supply fittings.
14. Waste fittings.
15. Grout.

B. Related Requirements:

1. Section 224213.13 "Commercial Water Closets."
2. Section 224213.16 "Commercial Urinals."
3. Section 224216.13 "Commercial Lavatories."
4. Section 224216.16 "Commercial Sinks."
5. Section 224223 "Commercial Showers."
6. Section 224300 "Healthcare Plumbing Fixtures."
7. Section 224500 "Emergency Plumbing Fixtures."
8. Section 224600 "Security Plumbing Fixtures."
9. Section 224713 "Drinking Fountains."
10. Section 224716 "Pressure Water Coolers."
11. Section 224723 "Remote Water Coolers."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

1.5 WARRANTY

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

2.2 BATHTUBS

A. Bathtubs with Shower - PMMA :

1. PMMA Bathtubs:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Kohler Co.
      3) Swan Corporation (The).
2. Fixture:
   a. Standard:
      1) ASME A112.19.1/CSA B45.2 for enameled bathtubs.
      2) IAPMO Z124/CSA B45.5 for PMMA plastic bathtubs.
   b. Bathing Surface: Slip resistant.
   c. Color: White .
   d. Drain: NPS 1-1/2; chrome-plated brass, pop-up waste and overflow.
3. Faucet: .
4. Supply Fittings: Included in faucet.
5. Tub Filler: Chrome-plated-brass diverter spout.
6. Waste Fittings:
   a. Standard: ASME A112.18.2/CSA B125.2.
   b. Drain: Stainless steel or chrome-plated brass, removable strainer.
   c. Overflow: Chrome-plated-brass escutcheon with toggle drain-plug device.
   d. Drain Piping:
      1) Schedule 40 PVC, NPS 1-1/2 P-trap, and waste.

2.3 BATHTUB FAUCETS

A. NSF Standard: Comply with NSF61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Bathtub Faucets - Single Handle, Pressure Balance :

1. Pressure-Balance Faucets:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1) American Standard.
   2) Kohler Co.
   3) Moen Incorporated.

2. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016/ASME A112.1016/CSA B125.16.
3. Faucet:
   a. Body Material: Solid brass.
   b. Finish: Polished chrome plate.
   c. Maximum Flow Rate: 2.5 gpm unless otherwise indicated.
   d. Mounting: Concealed .
   e. Operation: Single handle, push-pull or twist-or-rotate control, with hot- and cold-water indicators.
   f. Antiscald Device: Integral with mixing valve .
   g. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
   h. Diverter: In-tub filler spout.
   i. Supply Connections: NPS 1/2.
4. Shower Head:
   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Type: Ball joint with arm and flange Without ball joint, but with arm and flange Hand shower. Include wall-mounting device .
   c. Backflow-Prevention Device: ASSE 1014.
   d. Shower Head Material: Metallic with chrome-plated finish.
   e. Spray Pattern: Adjustable .
   f. Integral Volume Control: 2.0 GPM maximum .
   g. Shower-Arm, Flow-Control Fitting: Not required .
   h. Temperature Indicator: Not required.
5. Bathtub Filler Spout: Chrome-plated brass.

2.4 LAVATORIES

A. Lavatories - Vitreous China , Counter Top Mounted :

1. Vitreous-China Lavatories:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) American Standard.
      2) Kohler Co.
      3) Peerless Pottery Sales, Inc.
2. Fixture:
   a. Standard:
      1) IAPMO Z124.3/ANSI Z124.3 for PMMA lavatories.
      2) ASME A112.19.3/CSA B45.4 for stainless steel lavatories.
      3) ASME A112.19.2/CSA B45.1 for vitreous-china lavatories.
   b. Type: Self-rimming.
   c. Oval Nominal Size: 20 by 17 inches .
   d. Faucet-Hole Punching: Three holes, 2-inch centers .

e. Faucet-Hole Location: Rim.
f. Color: Selected by architect .

3. Faucet: .
4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article.

2.5 LAVATORY FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets Valve - Two Handle, Mixing :

1. General-Duty, Solid-Brass Faucets:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Delta Faucet Company.
      3) Kohler Co.
      4) Peerless.
2. General-Duty, Copper- or Brass-Underbody Faucets:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Eljer, Inc.
      3) Peerless.
3. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
4. Standard: ASME A112.18.1/CSA B125.1.
5. Body Material: General duty, solid brass .
6. Finish: Polished chrome plate .
7. Maximum Flow Rate: 1.5 GPM 2.2 gpm .
8. Centers: 4 inches .
9. Mounting: Deck, exposed .
10. Valve Handle(s): Lever .
11. Inlet(s): NPS 3/8 tubing, with NPS 1/2 male adaptor NPS 1/2 male shank .
12. Spout: Rigid Rigid, gooseneck .
13. Spout Outlet: Aerator .
14. Drain: Pop up .

2.6 SHOWERS

A. Showers - Standard PMMA with Base and Faucet :

1. PMMA Showers:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1) Aqua Bath Company, Inc.
   2) Kohler Co.
   3) Swan.

2. Standard: IAPMO Z124.1.2/ANSI Z124.1.2.
3. Surround:
   a. One piece.
   b. Surround: One piece.
4. Bathing Surface: Slip resistant.
5. Color: White .
6. Faucet: .

B. Showers - Accessible, PMMA with Seat, Grab Bar, Base, and Faucet :

1. PMMA Showers:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Aqua Bath Company, Inc.
      2) Clarion Bathware.
      3) Sterling.
      4) swan.
2. Standards: IAPMO Z124.1.2/ANSI Z124.1.2 and ICC/ANSI A117.1 for roll-in shower compartments.
3. Bathing Surface: Slip resistant.
4. Color: White .
5. Accessibility Options: Grab bar and bench.
6. Faucet: Shower .
7. Drain: Grid, NPS 2.

2.7 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Shower Faucets :

1. Single-Handle, Pressure-Balance Faucets:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Kohler Co.
      3) Peerless.
2. Fixture:
   a. Description: Include hot- and cold-water indicators, check stops, and handheld head complying with ASSE 1014 with arm, flange, hose, and bracket. Coordinate faucet inlets with supplies.

b. Standard: ASME A112.18.1/CSA B125.1 and ASSE 1016.
c. Body Material: Solid brass with nonmetallic trim.
d. Finish: Polished chrome plate .
e. Maximum Flow Rate: 2.5 gpm unless otherwise indicated.
f. Mounting: Exposed .
g. Backflow-Prevention Device for Handheld Shower: Required .
h. Antiscald Device: Integral with mixing valve Separate unit .
i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

3. Supply Connections: NPS 1/2 .
4. Shower Head:
   a. Type: Ball joint and head integral with mounting flange Handheld, slide-bar mounted .
   b. Shower Head Material: Nonmetallic with chrome-plated finish.
   c. Spray Pattern: Fixed .
   d. Integral Volume Control: 2.0 GPM .
   e. Shower-Arm, Flow-Control Fitting: Not required .

2.8 KITCHEN SINKS

A. Kitchen Sinks - Counter Mounted :

1. Stainless Steel Kitchen Sinks:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Elkay.
      3) Sterling.
2. Fixture:
   a. IAMPO Z124.3/ANSI Z124.3 for PMMA kitchen sinks.
   b. IAMPO Z124.3/ANSI Z124.3 for solid-surface kitchen sinks.
   c. ASME A112.19.3/CSA B45.4 for stainless steel kitchen sinks.
   d. Metal Thickness: 0.050 inch .
   e. Left Bowl:
      1) Dimensions: .
      2) Drain: 3-1/2-inch [**crumb cup**] [**grid**] [**grid with offset waste**] [**outlet for disposer**].
         a) Location: [**Centered in bowl**] [**Near back of bowl**] <**Insert location**>.
3. Faucet: .
4. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
5. Waste Fittings: Comply with requirements in "Waste Fittings" Article, except include continuous waste for multibowl sinks.
   a. Disposer: Insinkerator badger 5 .

2.9 LAUNDRY TRAYS

2.10 SINK FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Sink Faucets :

1. General-Duty, Solid-Brass Faucets:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) American Standard.
      2) Peerless.

2.11 DISPOSERS

A. Disposers Continuous-Feed Household, Food Waste:

1. Continuous-Feed Disposers:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) InSinkErator; Emerson Electric Co., Commercial and Residential Solutions.
      2) KitchenAid; a division of Whirlpool Corporation.
      3) Maytag; a division of Whirlpool Corporation.
2. Standards: ASSE 1008 and UL 430, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. General: Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless steel grinder or shredder; NPS 1-1/2 outlet; quick-mounting, stainless steel sink flange; antisplash guard; and combination cover/stopper.
4. Motor: 115 V ac, 1725 rpm, 1/2 hp with overload protection.

2.12 WATER CLOSETS

A. Water Closets : Floor mounted, floor outlet, close coupled (gravity tank), vitreous china, 1.28 gal./flush .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard.
   b. Eljer, Inc.
   c. Gerber Plumbing Fixtures LLC.
   d. Kohler Co.
   e. TOTO USA, INC.
2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1, ASME A112.19.5/CSA B45.15, and ASSE 1037/ASME A112.1060/CSA B125.16.
b. Bowl Type: Siphon jet .
c. Height: Standard Handicapped/elderly.
d. Rim Contour: Elongated .
e. Water Consumption: Water saving .
f. Color: White .

3. Toilet Seat: .
4. Supply Fittings:
   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
   c. Stop: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.
      1) Operation: Wheel handle .
   d. Riser:
      1) Size: NPS 3/8 .
      2) Material: Chrome-plated, soft-copper flexible tube riser.

2.13 TOILET SEATS

A. Toilet Seats :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Bemis Manufacturing Company.
   c. Kohler Co.
2. Standard: IAPMO Z124.5/ANSI Z124.5.
3. Material: Plastic.
4. Type: Residential .
5. Shape: Elongated rim (Closed front).
6. Configuration: Closed front with cover.
7. Size: Elongated .
8. Hinge Type: Self-sustaining .
9. Hinge Material: Plastic.
10. Seat Cover: Required .
11. Color: White .

2.14 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Lavatory Kitchen Sink Supply Fittings:

1. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
2. Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.
   a. Operation: Wheel handle .
3. Risers:
   a. Size:
      1) NPS 3/8 for lavatories.
      2) NPS 3/8 for kitchen sinks .
   b. Material: ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless-steel flexible hose riser.

2.15 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Pop-up type with NPS 1-1/4 straight tailpiece as part of faucet for standard lavatories.

C. Trap:

1. Size:
   a. NPS 1-1/4 for lavatories.
   b. NPS 1-1/2 for kitchen sinks .
2. Material:
   a. Chrome-plated, ; and chrome-plated-brass or -steel wall flange.
   b. ASTM F409 PVC two-piece trap and waste to wall and wall flange.

2.16 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000 psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumbing fixtures level and plumb in accordance with roughing-in drawings.

B. Install floor-mounted water closets on closet flange attachments to drainage piping.

C. Install counter-mounting fixtures in and attached to casework.

D. Install pedestal lavatories on pedestals and secured to wood blocking in wall.

E. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Use ball or gate valves if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

F. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

G. Install toilet seats on water closets.

H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

I. Install shower flow-control fittings with specified maximum flow rates in shower arms.

J. Install traps on fixture outlets.

1. Omit trap on fixtures with integral traps.
2. Omit trap on indirect wastes unless otherwise indicated.

K. Install disposer in outlet of each sink indicated to have a disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

L. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.

M. Set bathtubs and shower receptors in leveling bed of cement grout.

N. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories . Comply with requirements in Section 220719 "Plumbing Piping Insulation."

O. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

P. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories . Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 ADJUSTING

A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.4 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.

B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224100

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor-mounted, bottom-outlet water closets.
2. Flushometer valves.
3. Toilet seats.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential water closets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. All water closets shall be water sense certified.
2. Comply with ASME A112.19.2/CSA B45.1 for water closets.
3. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
4. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
5. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
6. Comply with ASME A112.6.1M for water-closet supports.
7. Comply with ICC A117.1 for ADA-compliant water closets.
8. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous china water closets to sanitary drainage systems.
9. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

2.2 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets - Floor Mounted, Bottom Outlet, Top Spud: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Kohler Co.
c. TOTO USA, INC.
d. Zurn Industries, LLC.

2. Bowl:
a. Material: Vitreous china.
b. Type: Siphon jet.
c. Style: Flushometer valve.
d. Height: Standard ADA compliant.
e. Rim Contour: Elongated.
f. Water Consumption: 1.28 gal. per flush.
g. Spud Size and Location: NPS 1-1/2; top.
h. Color: White .

3. Flushometer Valve: .
4. Toilet Seat: .

B. Water Closets - Floor Mounted, Bottom Outlet, Close-Coupled Flushometer Tank: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. American Standard.
b. Kohler Co.
c. Zurn Industries, LLC.

2. Bowl:
a. Material: Vitreous china.
b. Type: Siphon jet.
c. Style: Flushometer tank, gravity .
d. Height: Standard ADA compliant.
e. Rim Contour: Elongated.
f. Water Consumption: 1.28 gal. per flush.
g. Color: White .

3. Toilet Seat: .

2.3 FLUSHOMETER VALVES

A. Flushometer Valves - Diaphragm, Lever Handle: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Sloan Valve Company.
b. Zurn Industries, LLC.

2. Minimum Pressure Rating: 125 psig.
3. Features: Include integral check stop and backflow-prevention device.
4. Material: Brass body with corrosion-resistant components.
5. Style: Exposed.
6. Flushometer-Valve Finish: Chrome-plated.
7. Handle Finish: Chrome-plated .
8. Consumption: 1.28 gal. per flush.

9. Minimum Inlet: NPS 1.
10. Minimum Outlet: NPS 1-1/4.

B. Flushometer Valves - Piston, Lever Handle: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Kohler Co.
   c. TOTO USA, INC.
2. Minimum Pressure Rating: 125 psig.
3. Features: Include integral check stop and backflow-prevention device.
4. Material: Brass body with corrosion-resistant components.
5. Style: Exposed.
6. Flushometer-Valve Finish: Chrome-plated.
7. Handle Finish: Chrome-plated .
8. Consumption: 1.28 gal. per flush.
9. Minimum Inlet: NPS 1.
10. Minimum Outlet: NPS 1-1/4.

2.4 TOILET SEATS

A. Toilet Seats: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Church Seats; Bemis Manufacturing Company.
   c. Kohler Co.
   d. TOTO USA, INC.
   e. Zurn Industries, LLC.
2. Material: Plastic.
3. Type: Commercial (Heavy duty).
4. Shape: Elongated rim, open front .
5. Hinge: Check .
6. Hinge Material: Noncorroding metal.
7. Seat Cover: Not required.
8. Color: White .
9. Surface Treatment: Not required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
5. Measure support height installation from finished floor, not structural floor.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations easily reachable for people with disabilities.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vitreous-china, counter-mounted lavatories.
2. Vitreous-china, wall-mounted lavatories.
3. Manually operated lavatory faucets.
4. Supply fittings.
5. Waste fittings.
6. Lavatory supports.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential lavatories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

A. Lavatory - Self-Rimming, Vitreous China, Counter Mounted :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Kohler Co.
   c. TOTO USA, INC.
2. Fixture:
   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: Self-rimming for above-counter mounting.
   c. Nominal Size:
      1) Oval, 20 by 17 inches .

2) Round, 19 inches .
d. Faucet-Hole Punching: One hole Three holes, 2-inch centers .
e. Faucet-Hole Location: Top.
f. Color: White .
g. Mounting Material: Sealant.
3. Faucet: .

B. Lavatory - Vitreous China, Undercounter Mounted :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. American Standard.
b. Kohler Co.
c. TOTO USA, INC.
2. Fixture:
a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For undercounter mounting.
c. Nominal Size: Oval, 19 by 16 inches 22 by 14 inches .
d. Faucet-Hole Punching: No holes.
e. Faucet-Hole Location: On countertop.
f. Color: White .
g. Mounting Material: Sealant and undercounter mounting kit.
3. Faucet: .

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory - Vitreous China, Wall Mounted, with Back :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. American Standard.
b. Gerber Plumbing Fixtures LLC.
c. Kohler Co.
2. Fixture:
a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Nominal Size: Rectangular, 18 by 16 inches .
d. Faucet-Hole Punching: One hole Three holes, 2-inch centers .
e. Faucet-Hole Location: Top.
f. Color: White .
g. Mounting Material: Chair carrier.
3. Faucet: .
4. Support: Type II, concealed-arm lavatory carrier . Include rectangular, steel uprights.
5. Lavatory Mounting Height: Standard Handicapped/elderly in accordance with ICC A117.1.

B. Lavatory - Ledge Back, Vitreous China, Wall Mounted :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Gerber Plumbing Fixtures LLC.
   c. Kohler Co.
2. Fixture:
   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: For wall hanging.
   c. Nominal Size: Rectangular, 19 by 17 inches 20 by 18 inches .
   d. Faucet-Hole Punching: One hole Three holes, 2-inch centers .
   e. Faucet-Hole Location: Top.
   f. Color: White .
   g. Mounting Material: Chair carrier.
3. Faucet: .
4. Support: Type II, concealed-arm lavatory carrier . Include rectangular, steel uprights .
5. Lavatory Mounting Height: Standard Handicapped/elderly in accordance with ICC A117.1.

2.3 MANUALLY OPERATED LAVATORY FAUCETS

A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Lavatory Faucets - Manual Type: Single-control mixing , commercial , .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard.
   b. Chicago Faucets; Geberit Company.
   c. Kohler Co.
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: Centerset Single hole .
5. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
6. Finish: Polished chrome plate .
7. Maximum Flow Rate: 0.5 gpm .
8. Maximum Flow: 0.25 gal. per metering cycle.
9. Mounting Type: Deck, exposed .
10. Valve Handle(s): Single lever Wrist blade, 4 inches .
11. Spout: Rigid type.
12. Spout Outlet: Aerator .

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key .

F. Risers:

1. NPS 3/8 .
2. ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4 NPS 1-1/4.
2. Material:
   a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall ; and chrome-plated, brass or steel wall flange.
   b. Stainless steel, two-piece trap and swivel elbow with 0.012-inch- thick stainless steel tube to wall; and stainless steel wall flange.

2.6 LAVATORY SUPPORTS

A. Lavatory Carrier:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lavatories level and plumb in accordance with roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.2 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
   a. Constant-volume air systems.
2. Testing, adjusting, and balancing of fuel oil systems for HVAC.
3. Testing, adjusting, and balancing of equipment.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

G. UFAD: Underfloor air distribution.

1.3 ACTION SUBMITTALS

1.4 INFORMATIONAL SUBMITTALS

A. Certified TAB reports.

B. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. TAB Specialists Qualifications, Certified by NEBB [**or**] TABB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.6 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.

F. Examine equipment performance data, including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.

L. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
   a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
   b. Duct systems are complete with terminals installed.
   c. Volume, smoke, and fire dampers are open and functional.
   d. Clean filters are installed.
   e. Fans are operating, free of vibration, and rotating in correct direction.
   f. Variable-frequency controllers' startup is complete and safeties are verified.
   g. Automatic temperature-control systems are operational.
   h. Ceilings are installed.
   i. Windows and doors are installed.
   j. Suitable access to balancing devices and equipment is provided.
2. Hydronics:
   a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
   b. Piping is complete with terminals installed.
   c. Water treatment is complete.
   d. Systems are flushed, filled, and air purged.
   e. Strainers are pulled and cleaned.
   f. Control valves are functioning in accordance with the sequence of operation.
   g. Shutoff and balance valves have been verified to be 100 percent open.
   h. Pumps are started and proper rotation is verified.
   i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   j. Variable-frequency controllers' startup is complete and safeties are verified.
   k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
4. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

1. Pumps.
2. Fans and ventilators.
3. Terminal units.
4. Furnaces.
5. Air-handling units.
6. Packaged air conditioners.
7. Self-contained air conditioners.
8. Split-system air conditioners.
9. Variable-refrigerant-flow systems.
10. Heat pumps.
11. Unit ventilators.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' Record drawings duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
   a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
   b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
   c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
2. Measure fan static pressures as follows:
   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report artificial loading of filters at the time static pressures are measured.
3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent . If design value is less than 100 cfm, within 10 cfm.
2. Air Outlets and Inlets: Plus or minus 10 percent . If design value is less than 100 cfm, within 10 cfm.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.8 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

3.9 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Field test reports prepared by system and equipment installers.
2. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms, including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Heating coil, dry-bulb conditions.
    e. Other system operating conditions that affect performance.
16. Test conditions for pump performance forms, including the following:
    a. Other system operating conditions that affect performance.

D. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and size.
    e. Arrangement and class.
    f. Sheave make, size in inches, and bore.
2. Motor Data:
    a. Motor make, and frame type and size.
    b. Horsepower and speed.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave and amount of adjustments in inches.
    g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan speed.

d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

E. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
   a. System fan and air-handling-unit number.
   b. Location and zone.
   c. Traverse air temperature in deg F.
   d. Duct static pressure in inches wg.
   e. Duct size in inches.
   f. Duct area in sq. ft..
   g. Indicated airflow rate in cfm.
   h. Indicated velocity in fpm.
   i. Actual airflow rate in cfm.
   j. Actual average velocity in fpm.
   k. Barometric pressure in psig.

F. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return.
4. Indoor, exposed return.
5. Indoor, concealed exhaust within 4' of the building exterior.

B. Related Sections:

1. Section 230716 "HVAC Equipment Insulation."
2. Section 230719 "HVAC Piping Insulation."
3. Section 233113 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type III with factory-applied FSK jacket . Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Owens Corning.

G. High-Temperature, Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1000 deg F. Comply with ASTM C553, Type V.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Owens Corning.

H. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ . Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Owens Corning.

I. High-Temperature, Glass-Fiber Board: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III, unfaced.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.

2.3 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. 3M Industrial Adhesives and Tapes Division.
   b. Ideal Tape Co., Inc., an American Biltrite Company.
   c. Knauf Insulation.
2. Width: 3 inches .
3. Thickness: 11.5 mils .
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. 3M Industrial Adhesives and Tapes Division.
   b. Ideal Tape Co., Inc., an American Biltrite Company.
   c. Knauf Insulation.
2. Width: 3 inches .
3. Thickness: 6.5 mils .
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.4 SECUREMENTS

A. Aluminum Bands: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.

b. RPR Products, Inc.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.
      2) Gemco.
      3) Midwest Fasteners, Inc.
   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel , fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Gemco.
      2) Midwest Fasteners, Inc.
   b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
   c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.
      2) Gemco.
      3) Midwest Fasteners, Inc.
   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel , fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.
      2) Gemco.
      3) Midwest Fasteners, Inc.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Gemco.
      2) Midwest Fasteners, Inc.

2.5 CORNER ANGLES

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

3.4 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

B. Comply with manufacturer's written installation instructions.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch

o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not overcompress insulation during installation.

e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply, return, and outdoor air intake.
2. Indoor, exposed supply, return, and outdoor air intake.
3. Indoor, concealed exhaust 4' from penetration of building exterior.

3.6 INDOOR DUCT INSIDE THE BUILDING ENVELOPE SCHEDULE

A. Concealed, Supply-Air Duct liner: Glass-fiber board , 1/2 inch thick and 3 lb/cu. ft. nominal density.

B. Concealed, Supply-Air Duct wrap: Glass-fiber blanket duct wrap, 1 inch thick and [0.75 lb/cu. ft. nominal density.

C. Concealed, Return-Air Duct liner: Glass-fiber board , 1/2 inch thick and 3 lb/cu. ft. nominal density.

D. Concealed, Outdoor-Air Duct wrap: Glass-fiber blanket , 3 inches thick and 0.75 lb/cu. ft. nominal density.

E. Concealed, Exhaust-Air Duct wrap: Glass-fiber blanket , 3 inches thick and 0.75 lb/cu. ft. nominal density.

F. Exposed, Supply-Air Duct liner: Glass-fiber board , 1 inch thick and 3 lb/cu. ft. nominal density.

3.7 ABOVEGROUND, DUCT IN UNCONDITIONED SPACE INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Concealed, Supply-Air Duct wrap: Glass-fiber blanket , 2 inches thick and 0.75 lb/cu. ft. nominal density.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulation for HVAC piping systems.

B. Related Requirements:

1. Section 230713 "Duct Insulation" for duct insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials, Type II, for sheet materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA.
   b. Armacell LLC.
   c. K-Flex USA.

E. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. Owens Corning.
   c. ROCKWOOL Technical Insulation.
2. Preformed Pipe Insulation: Type II, Grade A .
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.

F. Polyolefin: Polyethylene thermal plastic insulation. Comply with or ASTM C1427, Type I, Grade 1, for tubular materials and with Type II, Grade 1, for sheet materials , self-seal.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armacell LLC.
   b. Nomaco.
   c. Sekisui Voltek, LLC.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

E. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents.

F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

G. Install insulation with least number of joints practical.

H. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
   3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

I. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

J. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
4. For below-ambient services, apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

K. Cut insulation in a manner to avoid compressing insulation.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

N. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.7 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.8 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1/2" thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1" thick.

3.10 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1" thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation is the following:
   a. Flexible Elastomeric: 1" thick.

END OF SECTION 230719

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Manual gas shutoff valves.
5. Pressure regulators.
6. Dielectric unions.

1.2 ACTION SUBMITTALS

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less .

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. FlashShield Products; Gastite, a division of Titeflex Corp.
   b. TracPipe CounterStrike; Omega Flex, Inc.
2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
3. Coating: PE with flame retardant.
   a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      1) Flame-Spread Index: 25 or less.
      2) Smoke-Developed Index: 50 or less.
4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
5. Striker Plates: Steel, designed to protect tubing from penetrations.
6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 5 psig.

C. PE Pipe: ASTM D 2513, SDR 11.

1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
   b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
   c. Aboveground Portion: PE transition fitting.
   d. Outlet shall be threaded or suitable for welded connection.
   e. Tracer wire connection.
   f. Ultraviolet shield.
   g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
4. Transition Service-Line Risers: Factory fabricated and leak tested.
   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.

b. Outlet shall be threaded or suitable for welded connection.
c. Bridging sleeve over mechanical coupling.
d. Factory-connected anode.
e. Tracer wire connection.
f. Ultraviolet shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig .
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. BrassCraft Manufacturing Co.; a Masco company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. BrassCraft Manufacturing Co.; a Masco company.
   c. Perfection Corporation.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Apollo Flow Controls; Conbraco Industries, Inc.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. A.Y. McDonald Mfg. Co.
   b. Lee Brass Company.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. American Meter Company.
   b. Invensys.
   c. Maxitrol Company.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 5 psig .

2.7 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jomar Valve.
   b. WATTS.
   c. Zurn Industries, LLC.
2. Description:
   a. Standard: ASSE 1079.
   b. Pressure Rating: 125 psig minimum at 180 deg F .
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.8 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Install fittings for changes in direction and branch connections.

3.2 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Verify final equipment locations for roughing-in.

K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

P. Connect branch piping from top or side of horizontal piping.

Q. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.

R. Do not use natural-gas piping as grounding electrode.

S. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for steel piping , with maximum horizontal spacing and minimum rod diameter, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for corrugated stainless-steel tubing, with maximum horizontal spacing and minimum rod diameter, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of corrugated stainless-steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

A. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

A. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

B. Natural-gas piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be one of the following:

1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.10 INDOOR PIPING SCHEDULE

A. Aboveground, branch piping 1/2" and smaller shall be the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

2. Steel pipe with wrought-steel fittings and welded joints.

3.11 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.

B. Underground: PE valves.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves in branch piping for single appliance shall be one of the following:

1. Two-piece, -port, bronze ball valves with bronze trim.
2. Bronze plug valve.

END OF SECTION 231123

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Valves and specialties.
4. Refrigerants.

1.2 ACTION SUBMITTALS

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings, Brazed-Joint: ASME B16.50.

C. Copper-Tube, Pressure-Seal-Joint Fittings for Refrigerant Piping:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conex Banninger - USA.
   b. Parker Hannifin, Sporlan Division.
   c. RLS LLC.
2. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
3. Housing: Copper.
4. O-Rings: HNBR or compatible with specific refrigerant.
5. Tools: Manufacturer's approved special tools.
6. Minimum Rated Pressure: 700 psig.

2.3 VALVES AND SPECIALTIES

A. Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
4. Piston: Removable polytetrafluoroethylene seat.
5. Closing Spring: Stainless steel.
6. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
7. End Connections: Socket, union, threaded, or flanged.
8. Maximum Opening Pressure: 0.50 psig.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 275 deg F.

B. Service Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
2. Body: Forged brass with brass cap including key end to remove core.
3. Core: Removable ball-type check valve with stainless-steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig.

C. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
2. Body and Bonnet: Plated steel.
3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24 -V ac coil.
7. Working Pressure Rating: 400 psig.
8. Maximum Operating Temperature: 240 deg F.

D. Thermostatic Expansion Valves: Comply with AHRI 750.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies; Emerson Electric Co.
   c. Heldon Products; Henry Technologies.
2. Body, Bonnet, and Seal Cap: Forged brass or steel.
3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Packing and Gaskets: Non-asbestos.
5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
6. Superheat: Nonadjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 450 psig .

E. Permanent Filter Dryers: Comply with AHRI 730.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
2. Body and Cover: Painted-steel shell.
3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
4. Desiccant Media: Activated alumina .
5. Designed for reverse flow (for heat-pump applications).
6. End Connections: Socket.
7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: 2 psig .
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

2.4 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Arkema Inc.
   b. DuPont Fluorochemicals Div.
   c. Genetron Refrigerants; Honeywell International Inc.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Hot-Gas and Liquid Lines , and Suction Lines for Heat-Pump Applications:

1. Copper, Type ACR , annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
2. Copper, Type ACR , drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
3. Copper, , drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install valves in suction and discharge lines of compressor.

B. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

C. Except as otherwise indicated, install valves on inlet and outlet side of filter dryers.

D. Install a full-size, three-valve bypass around filter dryers.

E. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

F. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

G. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Compressor.

H. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

I. Install flexible connectors at compressors.

J. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to the authority having jurisdiction.

3.3 INSTALLATION OF PIPING, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic restraints in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

D. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.7 ADJUSTING

A. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

B. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

C. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.

3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

D. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 ACTION SUBMITTALS

1.4 INFORMATIONAL SUBMITTALS

1.5 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

D. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are actual inside sheet metal dimensions and include an allowance for duct liner insulation if applicable.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ductmate Industries, Inc.
   b. McGill AirFlow LLC.
   c. SEMCO, LLC; part of FlaktGroup.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-

support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch- minimum diameter for lengths 36 inches or less; 3/8-inch- minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corporation.
   b. Johns Manville; a Berkshire Hathaway company.
   c. Knauf Insulation.
2. Maximum Thermal Conductivity:
   a. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel ; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
8. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches .
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.

6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Ceiling radiation dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Corridor dampers.
10. Flange connectors.
11. Turning vanes.
12. Remote damper operators.
13. Duct-mounted access doors.
14. Flexible connectors.
15. Duct accessory hardware.

B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.
2. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
3. Section 284621.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.
4. Section 284621.13 "Conventional Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; CB-600 or comparable products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Cesco Products; a division of MESTEK, Inc.
3. Flex-Tek Group.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. Nailor Industries Inc.
7. NCA Manufacturing, Inc.
8. Pottorff.
9. Ruskin Company.
10. Safe Air - Dowco Products.
11. Vent Products Co., Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm .

D. Maximum System Pressure: 3-inch wg .

E. Frame: Hat-shaped, 0.06-inch- thick extruded aluminum , with welded corners or mechanically attached.

F. Blades: Multiple single-piece blades, off-center pivoted, maximum 6-inch width, 0.045-inch-thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Vinyl foam .

I. Blade Axles:

1. Material: Nonferrous metal Aluminum.
2. Diameter: 0.20 inch .

J. Tie Bars and Brackets: Aluminum .

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
   a. Sleeve Thickness: 20 gage minimum.
   b. Sleeve Length: 6 inches minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel Aluminum.
8. Screen Type: Bird .
9. 90-degree stops.

2.4 BAROMETRIC RELIEF DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; RCD CD or comparable products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Cesco Products; a division of MESTEK, Inc.
3. Greenheck Fan Corporation.
4. Lloyd Industries, Inc.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Pottorff.
8. Ruskin Company.
9. Safe Air - Dowco Products.
10. Vent Products Co., Inc.
11. .

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2400 fpm .

D. Maximum System Pressure: 3-inch wg .

E. Frame: Hat-shaped, 0.063-inch- thick extruded aluminum , with welded corners or mechanically attached.

F. Blades:

1. Multiple, 0.050-inch- thick aluminum sheet.
2. Maximum Width: 6 inches.
3. Action: Parallel.
4. Balance: Gravity.
5. Off-center pivoted End pivoted.

G. Blade Seals: Vinyl Neoprene.

H. Blade Axles: Stainless steel Nonmetallic.

I. Tie Bars and Brackets:

1. Material: Aluminum .
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Synthetic .

L. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.
3. .

2.5 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; MD-115 EB RD ED DW or comparable products by one of the following:
   a. Aire Technologies.
   b. American Warming and Ventilating; a Mestek Architectural Group company.
   c. Flexmaster U.S.A., Inc.
   d. Flex-Tek Group.
   e. McGill AirFlow LLC.
   f. Nailor Industries Inc.
   g. Pottorff.
   h. Ruskin Company.
   i. Safe Air - Dowco Products.
   j. Trox USA Inc.
   k. Vent Products Co., Inc.
2. Standard leakage rating , with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
   a. Frame: Hat-shaped, 0.0375-inch- thick, galvanized sheet steel .
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized -steel, 0.064 inch thick.
6. Blade Axles: Galvanized steel Stainless steel .
7. Bearings:
   a. Molded synthetic .
8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; MD-105 MD-106 SB or comparable products by one of the following:
   a. American Warming and Ventilating; a Mestek Architectural Group company.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.
   e. Ruskin Company.
   f. Safe Air - Dowco Products.
   g. Trox USA Inc.
   h. Vent Products Co., Inc.
   i. .
2. Standard leakage rating , with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.081-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Extruded-Aluminum Blades: 0.081-inch- thick extruded aluminum.
6. Blade Axles: Galvanized steel Stainless steel .
7. Bearings:
   a. Molded synthetic .
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; CD-110 CD-111 CD-160 CD-161 or comparable products by one of the following:
   a. American Warming and Ventilating; a Mestek Architectural Group company.
   b. Elgen Manufacturing.
   c. Flex-Tek Group.
   d. McGill AirFlow LLC.
   e. Nailor Industries Inc.
   f. Pottorff.
   g. Ruskin Company.
   h. Safe Air - Dowco Products.
   i. Trox USA Inc.
   j. Vent Products Co., Inc.
   k. .
2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating , with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames:
   a. U shaped.
   b. 0.05-inch- thick, galvanized sheet steel .
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized , roll-formed steel, 0.062 inch thick.
7. Blade Axles: Galvanized steel Stainless steel .
8. Bearings:
   a. Molded synthetic .
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
9. Blade Seals: Vinyl Neoprene.
10. Jamb Seals: Cambered stainless steel aluminum.
11. Tie Bars and Brackets: Galvanized steel Aluminum.
12. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; CD-75 CD-76 CD-100 CD-101 CD-145 CD-146 CD-150 CD-151 or comparable products by one of the following:
   a. American Warming and Ventilating; a Mestek Architectural Group company.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.
   e. Ruskin Company.
   f. Safe Air - Dowco Products.
   g. Trox USA Inc.
   h. Vent Products Co., Inc.
   i. .
2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating , with linkage outside airstream.
4. Suitable for horizontal or vertical applications.
5. Frames: Hat U -shaped, 0.081-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Extruded-Aluminum Blades: 0.081-inch- thick extruded aluminum.
7. Blade Axles: Galvanized steel Stainless steel .
8. Bearings:
   a. Molded synthetic .
9. Blade Seals: PVC Vinyl .
10. Jamb Seals: Cambered stainless steel.
11. Tie Bars and Brackets: Galvanized steel Aluminum.
12. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

E. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.6 CONTROL DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; RI CD-75 CD-76 CD-100 CD-101 or comparable products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Arrow United Industries.
3. Cesco Products; a division of MESTEK, Inc.
4. Flex-Tek Group.
5. Greenheck Fan Corporation.
6. Lloyd Industries, Inc.
7. McGill AirFlow LLC.
8. Metal Form Manufacturing, Inc.
9. Nailor Industries Inc.
10. NCA Manufacturing, Inc.
11. Pottorff.
12. Ruskin Company.
13. Safe Air - Dowco Products.
14. Vent Products Co., Inc.
15. Young Regulator Company.
16. .

B. Frames:

1. Hat U shaped.
2. 0.0375-inch- thick, galvanized sheet steel .

C. Blades:

1. Multiple blade with maximum blade width of 6.25 inches .
2. Blade Edging: Closed-cell neoprene PVC.

D. Blade Axles: 1/2-inch- diameter; galvanized steel ; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

E. Bearings:

1. Molded synthetic .

2.7 FIRE DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; FD-SB FDD-SB FD-SC FDD-C FD-C FD-R or comparable products by one of the following:

1. Aire Technologies.
2. American Warming and Ventilating; a Mestek Architectural Group company.
3. Arrow United Industries.
4. Cesco Products; a division of MESTEK, Inc.
5. Greenheck Fan Corporation.
6. Nailor Industries Inc.
7. NCA Manufacturing, Inc.
8. Pottorff.
9. Prefco.
10. Ruskin Company.
11. Safe Air - Dowco Products.
12. Vent Products Co., Inc.
13. Ward Industries; a brand of Hart & Cooley, Inc.
14. .

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Curtain type with blades outside airstream ; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.05 thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.024-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.8 CEILING RADIATION DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; C-S/R-A C/FSR-1 C/FSR-2 C-SR-WT C-SR-WTS or comparable products by one of the following:

1. Aire Technologies.
2. American Warming and Ventilating; a Mestek Architectural Group company.
3. Cesco Products; a division of MESTEK, Inc.
4. Nailor Industries Inc.
5. Pottorff.
6. Prefco.
7. Ruskin Company.
8. Safe Air - Dowco Products.
9. Ward Industries; a brand of Hart & Cooley, Inc.
10. .

B. General Requirements:

1. Labeled according to UL 555C by an NRTL.
2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

D. Blades: Galvanized sheet steel with refractory insulation.

E. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

F. Fire Rating: 1 hours.

2.9 COMBINATION FIRE AND SMOKE DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; F/S-3V-I F/S-3V-II F/S-RD-I or comparable products by one of the following:

1. Aire Technologies.
2. American Warming and Ventilating; a Mestek Architectural Group company.
3. Cesco Products; a division of MESTEK, Inc.
4. Greenheck Fan Corporation.
5. Nailor Industries Inc.
6. Pottorff.
7. Ruskin Company.
8. Safe Air - Dowco Products.
9. .

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Heat-Responsive Device: Resettable , 165 deg F rated, fire-closure device.

F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

G. Smoke Detector: Integral, factory wired for single-point connection.

H. Blades: Roll-formed, horizontal, interlocking overlapping , 0.063-inch- thick, galvanized sheet steel.

I. Leakage: Class I .

J. Rated pressure and velocity to exceed design airflow conditions.

K. Mounting Sleeve: Factory-installed, 0.039-inch- thick, galvanized sheet steel; length to suit wall or floor application.

L. Master control panel for use in dynamic smoke-management systems.

M. Damper Motors: two-position action.

N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

O. Accessories:

1. Auxiliary switches for signaling or position indication.
2. Test and reset switches , damper mounted.

2.10 CORRIDOR DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; F/S-3V-CR-I F/S-3V-CR-II or comparable products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Cesco Products; a division of MESTEK, Inc.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin Company.
6. Safe Air - Dowco Products.
7. .

B. General Requirements: Label combination fire and smoke dampers according to UL 555 for 1-hour or 1-1/2-hour rating by an NRTL.

C. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

D. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

E. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange.

F. Blades: Roll-formed, horizontal, overlapping, 0.034-inch- thick, galvanized sheet steel.

G. Mounting Sleeve: Factory-installed, 0.039-inch- thick, galvanized sheet steel; length to suit wall or floor application.

H. Damper Motors: two-position action.

I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

2.11 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Hardcast, Inc.
4. Nexus PDQ.
5. Ward Industries; a brand of Hart & Cooley, Inc.
6. .

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.12 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aero-Dyne Sound Control Co.
2. CL WARD & Family Inc.
3. Ductmate Industries, Inc.
4. Duro Dyne Inc.
5. Elgen Manufacturing.
6. Hardcast, Inc.
7. METALAIRE, Inc.
8. SEMCO LLC.
9. Ward Industries; a brand of Hart & Cooley, Inc.
10. .

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall.

F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.13 DUCT-MOUNTED ACCESS DOORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide United Enertech; O-95-H O-95-C L-95 or comparable products by one of the following:

1. Aire Technologies.
2. American Warming and Ventilating; a Mestek Architectural Group company.
3. Cesco Products; a division of MESTEK, Inc.
4. CL WARD & Family Inc.
5. Ductmate Industries, Inc.
6. Elgen Manufacturing.
7. Flexmaster U.S.A., Inc.
8. Greenheck Fan Corporation.
9. McGill AirFlow LLC.
10. Nailor Industries Inc.
11. Pottorff.
12. Ventfabrics, Inc.
13. Ward Industries; a brand of Hart & Cooley, Inc.
14. .

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.

2.14 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Elgen Manufacturing.
5. Hardcast, Inc.

6. JP Lamborn Co.
7. Ventfabrics, Inc.
8. Ward Industries; a brand of Hart & Cooley, Inc.
9. .

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd..
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd..
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.15 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install fire and smoke dampers according to UL listing.

G. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch- diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.

2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

I. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

J. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

N. Connect flexible ducts to metal ducts with draw bands .

O. Install duct test holes where required for testing and balancing purposes.

P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulated flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

A. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1 R6 .

B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1 R6 .

2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action Nylon strap in sizes 3 through 18 inches, to suit duct size.

B. Non-Clamp Connectors: .

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

D. Connect flexible ducts to metal ducts with draw bands .

E. Install duct test holes where required for testing and balancing purposes.

F. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

G. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.

3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 233346

SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backward-inclined centrifugal fans, including airfoil and curved blade fans.
2. Square in-line centrifugal fans.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product data showing compliance with Energy Star.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. All fans shall be Energy Star rated.

2.2 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acme Engineering & Manufacturing Corp.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. Loren Cook Company.

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, direct-driven centrifugal fans, consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
2. Factory-installed and -wired disconnect switch.

C. Housings:

1. Housing Material: Aluminum .
2. Housing Coating: None .
3. Formed panels to make curved-scroll housings with shaped cutoff.
4. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
5. Spun inlet cone with flange.

D. Shafts:

1. Statically and dynamically balanced, and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

E. Bearings:

1. Prelubricated and Sealed Shaft Bearings:
   a. Self-aligning, pillow-block-type ball bearings.

F. Motor Enclosure: Open, dripproof .

G. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

2.3 FORWARD-CURVED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acme Engineering & Manufacturing Corp.
2. Central Blower Company.
3. New York Blower Company (The).

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt- driven centrifugal fans, consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

C. Housings:

1. Housing Material: Aluminum .
2. Housing Coating: None .
3. Formed panels to make curved-scroll housings with shaped cutoff.
4. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
5. Spun inlet cone with flange.
6. Outlet flange.

D. Wheels:

1. Wheel and Blade Material: Aluminum .
2. Wheel and Blade Coating: None .
3. Cast-iron or cast-steel hub riveted to backplate and fastened to shaft with setscrews.
4. Forward-Curved Wheels:
   a. Black-enameled or galvanized-steel construction with inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow.
   b. Mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with setscrews.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Bearings:

1. Prelubricated and Sealed Shaft Bearings:
   a. Self-aligning, pillow-block-type ball bearings.

G. Motor Enclosure: Open, dripproof .

H. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

2.4 SQUARE IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acme Engineering & Manufacturing Corp.
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. Greenheck Fan Corporation.
4. Loren Cook Company.

B. Description: Square in-line centrifugal fans.

C. Housing:

1. Housing Material: Reinforced steel .
2. Housing Coating: None .
3. Housing Construction: Side panels shall be easily removable for service. Include inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosures around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum airfoil blades welded to aluminum hub.

F. Motor Enclosure: Open, dripproof .

G. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.5 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

B. Where variable-frequency drives are indicated or scheduled, provide fan motor compatible with variable-frequency drive.

2.6 SOURCE QUALITY CONTROL

A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.

B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.

C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.

D. Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:

1. Support duct-mounted and other hanging centrifugal fans directly from the building structure, using suitable hanging systems as specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Curb Support, Field Built-Up: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," detail "Equipment Support Curb," number "SPF-9" (page 1409) and detail "Equipment Support Curb," number "SPF-9S" (page 1410). Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction.

F. Curb Support, Prefabricated: Rail-type wood support provided by fan manufacturer.

G. Unit Support: Install centrifugal fans level on structural curbs . Coordinate with duct connections. Secure units to structural support with anchor bolts.

H. Install units with clearances for service and maintenance.

I. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK AND PIPING CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

D. Install heat tracing on all drain piping subject to freezing temperature and as indicated on Drawings. Furnish and install heat tracing according to Section 230533 "Heat Tracing for HVAC Piping."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

D. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.6 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: will engage a qualified testing agency to perform tests and inspections.

B. Prepare test and inspection reports.

3.8 DEMONSTRATION

A. Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233416

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ceiling-mounted ventilators.

1.3 ACTION SUBMITTALS

A. Product Data:

PART 2 - PRODUCTS

2.1 CEILING-MOUNTED VENTILATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. PennBarry.

B. Housing: Steel, lined with acoustical insulation.

C. Fans shall be Energy Star Rated

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel removable for service.

E. Back-draft damper: Integral.

F. Grille: Plastic , louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.

G. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

H. Accessories:

1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 INSTALLATION OF HVAC POWER VENTILATORS

A. Install power ventilators level and plumb.

B. Install units with clearances for service and maintenance.

C. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that there is adequate maintenance and access space.
4. Verify that cleaning and adjusting are complete.
5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
6. Adjust belt tension.
7. Adjust damper linkages for proper damper operation.
8. Verify lubrication for bearings and other moving parts.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
10. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
11. Shut unit down and reconnect automatic temperature-control operators.
12. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

C. Replace fan and motor pulleys as required to achieve design airflow.

END OF SECTION 233423

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Louver face diffusers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.
3. Section 233713.43 "Security Registers and Grilles" for security registers and security grilles.
4. Section 233716 "Fabric Air-Diffusion Devices" for continuous tubular diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Nailor Industries Inc.
2. Price Industries.
3. Titus; brand of Johnson Controls International plc, Global Products.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel .

D. Finish: Baked enamel, white .

E. Face Size: 12 by 12 inches .

F. Face Style: Three cone .

G. Mounting: Surface .

H. Pattern: Fixed .

I. Dampers: Butterfly .

2.2 LOUVER FACE DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Nailor Industries Inc.
2. Price Industries.
3. Titus; brand of Johnson Controls International plc, Global Products.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel .

D. Finish: Baked enamel, white .

E. Mounting: T-bar .

F. Pattern: Four-way core style.

G. Dampers: Butterfly .

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13

SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adjustable blade face registers and grilles.
2. Fixed face registers and grilles.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
2. Section 233713.13 "Air Diffusers" for various types of air diffusers.
3. Section 233713.43 "Security Registers and Grilles" for security registers and security grilles.
4. Section 233716 "Fabric Air-Diffusion Devices" for continuous tubular diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 REGISTERS

A. Fixed Face Register :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Nailor Industries Inc.
   b. Price Industries.
   c. Titus, a division of Air System Components; Johnson Controls, Inc.
2. Material: Steel .
3. Finish: Baked enamel, white .
4. Face Blade Arrangement: Horizontal [**Vertical**] spaced 3/4 inch [**1/2 inch**] apart.
5. Core Construction: Integral .
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw .
8. Damper Type: Adjustable opposed blade .
9. Accessory: Filter.

2.2 GRILLES

A. Adjustable Blade Face Grille :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. METALAIRE, Inc.
   b. Price Industries.
   c. Titus, a division of Air System Components; Johnson Controls, Inc.
2. Material: Steel .
3. Finish: Baked enamel, white .
4. Face Blade Arrangement: Horizontal Vertical spaced 3/4 inch 1/2 inch apart.
5. Core Construction: Integral .
6. Rear-Blade Arrangement: [**Horizontal**] Vertical spaced 3/4 inch 1/2 inch apart.
7. Frame: 1-1/4 inches wide.
8. Mounting: Countersunk screw .
9. Accessories:
   a. -blade gang operator.

B. Fixed Face Grille :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Nailor Industries Inc.
   b. Price Industries.
   c. Titus, a division of Air System Components; Johnson Controls, Inc.
2. Material: Steel .
3. Finish: Baked enamel, white .
4. Face Blade Arrangement: Horizontal ; spaced 3/4 inch 1/2 inch apart.
5. Core Construction: Integral .
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw .
8. Accessory: Filter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

SECTION 234100 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pleated panel filters.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:

1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
2. Comply with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PLEATED PANEL FILTERS

A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AAF International.
   b. AirGuard; Clarcor Air Filtration Products, Inc.
   c. Camfil Farr.
   d. Flanders Corporation.

B. Capacities and Characteristics:

1. Depth: 2 inches nominal.
2. Minimum Efficiency Reporting Value: MERV 8 , with "Composite Average Particle Size Efficiency, Percent in Size Range, Micrometers" according to ASHRAE 52.2.
3. Access: Side.

C. Media: Cotton and synthetic fibers coated with nonflammable adhesive.

1. Separators shall be bonded to the media to maintain pleat configuration.
2. Welded-wire grid shall be on downstream side to maintain pleat.
3. Media shall be bonded to frame to prevent air bypass.
4. Support members on upstream and downstream sides to maintain pleat spacing.

D. Filter-Media Frame: Cardboard frame with perforated metal retainer sealed or bonded to the media.

PART 3 - EXECUTION

3.1 INSTALLATION OF FILTERS

A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

B. Install filters in position to prevent passage of unfiltered air.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

D. Coordinate filter installations with duct and air-handling-unit installations.

END OF SECTION 234100

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:

1. Product Data: For refrigerants, indicating compliance with refrigerant management practices.
2. Product Data: For energy performance.

C. Shop Drawings:

1. Equipment submittals showing Energy Star compliance.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Air conditioners shall be Energy Star Rated

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:
   a. For Compressor: Five year(s) from date of Substantial Completion.

b. For Parts: One year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carrier Corporation.
2. Daikin.
3. First Operations LP.
4. Lennox Industries, Inc.; Lennox International.
5. Trane.
6. YORK; a Johnson Controls company.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
6. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
   c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Filters: Permanent, cleanable.
9. Condensate Drain Pans:
   a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1 .

2) Depth: A minimum of 2 inches deep.

b. Single-wall, stainless-steel sheet.

c. Double-wall, -steel sheet with space between walls filled with foam insulation and moisture-tight seal.

d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

1) Minimum Connection Size: 3/4 inch .

e. Pan-Top Surface Coating: Asphaltic waterproofing compound.

f. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

B. Floor-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
   a. Discharge Grille: Steel with surface-mounted frame .
   b. Insulation: Faced, glass-fiber duct liner.
   c. Drain Pans: Galvanized steel, with connection for drain; insulated.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
6. Air Filtration Section:
   a. General Requirements for Air Filtration Section:
      1) Comply with NFPA 90A.
      2) Minimum MERV according to ASHRAE 52.2.
      3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
   b. Disposable Panel Filters:
      1) Factory-fabricated, viscous-coated, flat-panel type.
      2) Thickness: 1 inch .
      3) MERV according to ASHRAE 52.2: 5 .
      4) Media: Interlaced glass fibers sprayed with nonflammable adhesive.
      5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

C. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.

2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
   c. Enclosure Type: Totally enclosed, fan cooled.
   d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
   e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
   f. Mount unit-mounted disconnect switches on exterior of unit.
   g. .
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:
   a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1 .
      2) Depth: A minimum of 1 inch deep.
   b. Single-wall, stainless-steel sheet.
   c. Double-wall, -steel sheet with space between walls filled with foam insulation and moisture-tight seal.
   d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
      1) Minimum Connection Size: 3/4 inch .
   e. Pan-Top Surface Coating: Asphaltic waterproofing compound.
8. Air Filtration Section:
   a. General Requirements for Air Filtration Section:
      1) Comply with NFPA 90A.
      2) Minimum MERV according to ASHRAE 52.2.
      3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
   b. Disposable Panel Filters:
      1) Factory-fabricated, viscous-coated, flat-panel type.
      2) Thickness: 1 inch .
      3) MERV according to ASHRAE 52.2: 5 .
      4) Media: Interlaced glass fibers sprayed with nonflammable adhesive.
      5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

E. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Water Coil Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

END OF SECTION 238126

SECTION 238239.19 - WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.3 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. INDEECO.
2. Markel Products; TPI Corporation.
3. QMark; Marley Engineered Products.

2.2 DESCRIPTION

A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

A. Front Panel: Stamped-steel louver , with removable panels fastened with tamperproof fasteners.

B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

C. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

A. Fan: Aluminum propeller directly connected to motor.

B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

A. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.

B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wall and ceiling unit heaters to comply with NFPA 90A.

B. Install wall and ceiling unit heaters level and plumb.

C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements applicable to Work specified in Division 26.

B. Related Requirements:

1. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. 8PSJ or 8P8C: Miniature 8-position series jack, also called an 8-position 8-contact modular jack for some applications.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. CO/ALR: Copper-aluminum, revised.
17. COPS: Critical operations power system.
18. CU or Cu: Copper.
19. CU-AL or AL-CU: Copper-aluminum.
20. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
21. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
22. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
23. dBm: Decibel absolute power with respect to 1 mW.

24. DC or dc: Direct current.
25. DCOA: Designated critical operations area.
26. DDC: Direct digital control (HVAC).
27. EGC: Equipment grounding conductor.
28. EMF: Electromotive force.
29. EMI: Electromagnetic interference.
30. EPM: Electrical preventive maintenance.
31. EPS: Emergency power supply.
32. EPSS: Emergency power supply system.
33. ESS: Energy storage system.
34. EV: Electric vehicle.
35. EVPE: Electric vehicle power export equipment.
36. EVSE: Electric vehicle supply equipment.
37. fc: Footcandle, a unit of illuminance equal to one lumen per square foot.
38. FLC: Full-load current.
39. ft: Foot.
40. GEC: Grounding electrode conductor.
41. GFCI: Ground-fault circuit interrupter.
42. GFPE: Ground-fault protection of equipment.
43. GND: Ground.
44. HACR: Heating, air conditioning, and refrigeration.
45. HDPE: High-density polyethylene.
46. HID: High-intensity discharge.
47. HP or hp: Horsepower.
48. HVAC: Heating, ventilating, and air conditioning.
49. Hz: Hertz.
50. IBT: Intersystem bonding termination.
51. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
52. IP: Ingress protection rating (enclosures); Internet protocol (communications).
53. IR: Infrared.
54. IS: Intrinsically safe.
55. IT&R: Inspecting, testing, and repair.
56. ITE: Information technology equipment.
57. kAIC: Kiloampere interrupting capacity.
58. kcmil or MCM: One thousand circular mils.
59. kV: Kilovolt.
60. kVA: Kilovolt-ampere.
61. kVAr or kVAR: Kilovolt-ampere reactive.
62. kW: Kilowatt.
63. kWh: Kilowatt-hour.
64. LAN: Local area network.
65. lb: Pound (weight).
66. LCD: Liquid-crystal display.
67. LCDI: Leakage-current detector-interrupter.
68. LED: Light-emitting diode.
69. LNG: Liquefied natural gas.
70. LP-Gas: Liquefied petroleum gas.
71. LRC: Locked-rotor current.
72. MCC: Motor-control center.
73. MDC: Modular data center.

74. MG set: Motor-generator set.
75. MIDI: Musical instrument digital interface.
76. MLO: Main lugs only.
77. MVA: Megavolt-ampere.
78. mW: Milliwatt.
79. MW: Megawatt.
80. MWh: Megawatt-hour.
81. NC: Normally closed.
82. NiCd: Nickel cadmium.
83. NIU: Network interface unit.
84. NO: Normally open.
85. NPT: National (American) standard pipe taper.
86. OCPD: Overcurrent protective device.
87. ONT: Optical network terminal.
88. PC: Personal computer.
89. PCS: Power conversion system.
90. PCU: Power-conditioning unit.
91. PF or pf: Power factor.
92. PHEV: Plug-in hybrid electric vehicle.
93. PLC: Programmable logic controller.
94. PLFA: Power-limited fire alarm.
95. PoE: Power over Ethernet.
96. PV: Photovoltaic.
97. PVC: Polyvinyl chloride.
98. pW: Picowatt.
99. RFI: Radio-frequency interference (electrical); Request for interpretation (contract).
100. RMS or rms: Root-mean-square.
101. RPM or rpm: Revolutions per minute.
102. SCADA: Supervisory control and data acquisition.
103. SCR: Silicon-controlled rectifier.
104. SPD: Surge protective device.
105. sq.: Square.
106. SWD: Switching duty.
107. TCP/IP: Transmission control protocol/Internet protocol.
108. TEFC: Totally enclosed fan-cooled.
109. TR: Tamper resistant.
110. TVSS: Transient voltage surge suppressor.
111. UL: Underwriters Laboratories, Inc. (standards) or UL LLC (services).
112. UL CCN: UL Category Control Number.
113. UPS: Uninterruptible power supply.
114. USB: Universal serial bus.
115. UV: Ultraviolet.
116. V: Volt, unit of electromotive force.
117. V(ac): Volt, alternating current.
118. V(dc): Volt, direct current.
119. VA: Volt-ampere, unit of complex electrical power.
120. VAr: Volt-ampere reactive, unit of reactive electrical power.
121. VFC: Variable-frequency controller.
122. VOM: Volt-ohm-multimeter.
123. VPN: Virtual private network.

124. VRLA: Valve-regulated lead acid.
125. W: Watt, unit of real electrical power.
126. Wh: Watt-hour, unit of electrical energy usage.
127. WPT: Wireless power transfer.
128. WPTE: Wireless power transfer equipment.
129. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit.
7. EPEC-40: Schedule 40 electrical HDPE underground conduit.
8. EPEC-80: Schedule 80 electrical HDPE underground conduit.
9. EPEC-A: Type A electrical HDPE underground conduit.
10. EPEC-B: Type B electrical HDPE underground conduit.
11. ERMC: Electrical rigid metal conduit.
12. ERMC-A: Aluminum electrical rigid metal conduit.
13. ERMC-S: Steel electrical rigid metal conduit.
14. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
15. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
16. ERMC-SS: Stainless steel electrical rigid metal conduit.
17. FMC: Flexible metal conduit.
18. FMC-A: Aluminum flexible metal conduit.
19. FMC-S: Steel flexible metal conduit.
20. FMT: Steel flexible metallic tubing.
21. FNMC: Flexible nonmetallic conduit. See LFNC.
22. HDPE: See EPEC.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.
36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
37. RGS: See ERMC-S-G.
38. RMC: See ERMC.
39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.

41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: Moisture-, heat-, and oil-resistant thermoplastic cable (machine tool wiring).
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.

40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: Thermoset rubber, heat-resistant cable (high heat).
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:

1. Basic Impulse Insulation Level: Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
2. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
3. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
4. Designated Seismic System: A system component that requires design in accordance with ASCE/SEI 7, Ch. 13 and for which the Component Importance Factor is greater than 1.0.
5. Direct Buried: Installed underground without encasement in concrete or other protective material.
6. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to

protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
b. Concrete Box: A box intended for use in poured concrete.
c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
f. Device Box: A box with provisions for mounting a wiring device directly to the box.
g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
o. Raised-Floor Box: A floor box intended for use in raised floors.
p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.

t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

7. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
8. Essential Electrical Systems: Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system. (healthcare facilities)
9. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
10. Jacket: A continuous nonmetallic outer covering for conductors or cables.
11. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
12. Miniature 8-Position Series Jack (8PSJ): Also called an 8-position 8-contact (8P8C) modular jack. An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Shape and dimensions are specified by TIA-1096.
    a. Caution: An 8PSJ is not the same thing as an FCC "registered jack" RJ45S, now called a miniature 8-position keyed jack (8PKJ). Ethernet cable plugs do not have rejection keys. Many manufacturers and suppliers incorrectly use "RJ45" as a generic term to describe any 8-position series plug or jack whether it has a rejection key or not.
13. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
14. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
15. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
16. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
17. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
18. Sheath: A continuous metallic covering for conductors or cables.
19. UL Category Control Number: An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
20. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
    a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.

c. Extra-Low Voltage: Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
d. Low Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
e. Medium Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.

1.3 COORDINATION

A. Arrange to provide temporary electrical power in accordance with requirements specified in Division 01.

1.4 SEQUENCING

A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.5 CLOSEOUT SUBMITTALS

1.6 QUALIFICATIONS

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

A. Substitution requests for electrical equipment will be entertained under the following conditions:

1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

2.2 FACILITY ELECTRICAL PREVENTIVE MAINTENANCE (EPM) PROGRAM BINDERS

A. Description: Set of binders containing operation and maintenance data for facility's electrical equipment that was compiled during analysis of installed electrical Work for Facility EPM Program development.

B. Applicable Standards:

1. Regulatory Requirements: Comply with recommendations in NFPA 70B.
2. General Characteristics:
   a. Volume 1 - Introduction:
      1) Summarize how Facility EPM Program Analysis was performed, how data were collected, and how volumes are organized.
      2) Describe Facility EPM Program and provide recommended policies and procedures for implementing the program and keeping it current.
      3) Provide place for Owner to identify contact information for employees responsible for implementing and maintaining Facility EPM Program.
   b. Volume 2 - Facility Safety, Hazards Awareness, and Emergency Procedures:
      1) Include training requirements for employees and contractors.
      2) Include list of known facility hazards impacting IT&R activities.
      3) Include approval and permitting procedures for IT&R activities.
      4) Include incident emergency response procedures.
      5) Include emergency shutdown procedures.
      6) Include electrical disaster recovery procedures.
   c. Volume 4 - Facility Diagrams and Schedules:
      1) Include single-line diagrams.
      2) Include grounding and bonding diagrams.
      3) Include essential wiring diagrams.
      4) Include records of switchgear, switchboard, and panelboard schedules.
      5) Include time-current curves for overcurrent protective devices.
   d. Volume 11 - Construction Project Closeout Record Documentation:
      1) Include records of power system studies and photometric studies.
      2) Include records of risk assessment studies.
      3) Include records of electrical system startup and commissioning activities.
      4) Include records of baseline inspections and tests.
      5) Include records of baseline infrared photographs with normal light photographs showing the location, direction, angle, and conditions necessary for reproducing each infrared photograph.
      6) Include records of baseline settings for adjustable equipment and devices.

PART 3 - EXECUTION

3.1 DEVELOPMENT OF FACILITY EPM PROGRAM

A. Facility EPM Program must be developed by qualified EPM specialist.

B. Conduct Facility EPM Program analysis in accordance with NFPA 70B recommendations.

C. Compile operation and maintenance data from Facility EPM Program analysis and submit Facility EPM Program Binders.

3.2 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

END OF SECTION 260010

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Metal-clad cable, Type MC, rated 600 V or less.
4. Fire-alarm wire and cable.
5. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
4. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. Cerro Wire LLC.
3. Encore Wire Corporation.
4. General Cable; Prysmian Group North America.

5. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type NM: Comply with UL 83 and UL 719.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
4. Type XHHW-2: Comply with UL 44.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. Cerro Wire LLC.
3. Encore Wire Corporation.
4. General Cable; Prysmian Group North America.
5. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

E. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.
2. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
3. Type XHHW-2: Comply with UL 44.

2.3 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; Atkore International.
2. Alpha Wire Company.
3. Encore Wire Corporation.
4. General Cable; Prysmian Group North America.
5. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multicircuit with color-coded conductors.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors Aluminum, complying with ASTM B800 and ASTM B801.

F. Ground Conductor: Bare .

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Aluminum, interlocked.

I. Jacket: PVC applied over armor.

2.4 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, undefined:

1. Allied Wire & Cable Inc.
2. CommScope, Inc.
3. Superior Essex Inc.
4. West Penn Wire.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG .

D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.5 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M Electrical Products.
2. ABB, Electrification Business.
3. AFC Cable Systems; Atkore International.
4. Gardner Bender.
5. Hubbell Incorporated, Power Systems.
6. Ideal Industries, Inc.
7. ILSCO.
8. NSi Industries LLC.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors must be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. Copper, Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway Multiconductor cable, Type SE.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway .

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway Metal-clad cable, Type MC Nonmetallic-sheathed cable, Type NM. Type NM cable shall be used within dwelling units ONLY.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway .

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway Metal-clad cable, Type MC Nonmetallic-sheathed cable, Type NM. Type NM cable shall be used within dwelling units ONLY.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway .

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

A. Comply with NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 280528 "Pathways for Electronic Safety and Security."

1. Install plenum cable in environmental airspaces, including plenum ceilings.
2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
   a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is permitted.
4. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.

D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backboards.
2. Category 6 balanced twisted pair cable.
3. Control cabling.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inch or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

2.2 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inch. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

B. Painting: Paint plywood on all sides and edges with flat white latex paint. Comply with requirements in Section 099123 "Interior Painting."

2.3 CATEGORY 6 BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 100 MHz.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMP NETCONNECT; a TE Connectivity Ltd. company.
2. Belden Inc.
3. Berk-Tek Leviton; a Nexans/Leviton alliance.
4. CommScope, Inc.
5. General Cable; Prysmian Group North America.
6. Mohawk; a division of Belden Networking, Inc.

C. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 6 cables.

D. Conductors: 100 ohm, No. 24 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP) .

F. Cable Rating: Plenum.

G. Jacket: Blue thermoplastic.

2.4 CONTROL CABLE

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. PVC insulation.
2. Unshielded.
3. PVC jacket.
4. Flame Resistance: Comply with NFPA 262.

2.5 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. CommScope, Inc.
3. Comtran Corporation.
4. Genesis Cable Products; Honeywell International, Inc.
5. nVent (PYROTENAX).
6. Prysmian Cables and Systems; Prysmian Group North America.
7. Superior Essex Inc.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG .

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Control-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Low-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

1. Outlet boxes must be no smaller than 4 inch square by 2-1/8 inch deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
2. Flexible metal conduit must not be used.

B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.

4. Extend conduits 3 inch above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96 inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inch and not more than 6 inch from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lay on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire must be copper, and grounding methods must comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inch above ceilings by cable supports not more than 30 inch apart.
3. Cable must not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of 72 inch <**Insert dimension**> of cable in a coil not less than [**12 inch**] in diameter.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.5 GROUNDING

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

3.6 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers must use label stocks, laminating adhesives, and inks complying with UL 969.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire must have a unique tag.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. Burndy; Hubbell Incorporated, Construction and Energy.
3. ERICO; nVent.
4. ILSCO.
5. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
6. Siemens Industry, Inc., Energy Management Division.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inch in cross section, with 9/32-inch holes spaced 1-1/8 inch apart. Stand-off insulators for mounting must comply with UL 891 for use in switchboards, 600 V and must be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Mechanical-Type Bus-Bar Connectors: Cast silicon bronze, solderless compression -type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Compression-Type Bus-Bar Connectors: Copper or copper alloy, with two wire terminals.

E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

G. Water Pipe Clamps:

1. U-bolt type with malleable-iron clamp and copper ground connector .

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel ; 3/4 inch by 10 ft. .

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG <**Insert wire size>** and smaller, and stranded conductors for No. 6 AWG <**Insert wire size>** and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG <**Insert wire size>** minimum.

1. Bury at least 30 inch below grade.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.

3.2 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
5. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Allied Tube & Conduit; Atkore International.
   c. B-line; Eaton, Electrical Sector.
   d. CADDY; nVent.
   e. Flex-Strut Inc.
   f. Unistrut; Atkore International.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

3. Material for Channel, Fittings, and Accessories: Galvanized steel .
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti, Inc.
      2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) B-line; Eaton, Electrical Sector.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti, Inc.
      4) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101
2. NECA NEIS 102.
3. NECA NEIS 105.
4. NECA NEIS 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."

D. Provide vibration controls with hangers and supports in accordance with requirements specified in

E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps .

G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT IMC and ERMC may be supported by openings through structure members, in accordance with NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To New Concrete: Bolt to concrete inserts.
2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
3. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT-S raceways and elbows.
2. Type ERMC-S raceways, elbows, couplings, and nipples.
3. Type FMC-S and Type FMC-A raceways.
4. Type LFMC raceways.
5. Type PVC raceways and fittings.
6. Fittings for conduit, tubing, and cable.
7. Threaded metal joint compound.
8. Solvent cements.
9. Surface metal raceways and fittings.
10. Wireways and auxiliary gutters.
11. Metallic outlet boxes, device boxes, rings, and covers.
12. Nonmetallic outlet boxes, device boxes, rings, and covers.
13. Cabinets, cutout boxes, junction boxes, and pull boxes.
14. Cover plates for device boxes.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Wireways and auxiliary gutters.
2. Surface metal raceways.
3. Floor boxes.
4. Cabinets and cutout boxes.

PART 2 - PRODUCTS

2.1 TYPE ERMC-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

2. General Characteristics: UL 6 and UL Category Control Number DYIX.

B. Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit; Atkore International.
   b. Calconduit; Atkore International.
   c. Crouse-Hinds; Eaton, Electrical Sector.
   d. Killark; Hubbell Incorporated, Construction and Energy.
   e. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
   f. Western Tube; Zekelman Industries.
2. Exterior Coating: Zinc.
3. Options:
   a. Interior Coating: Zinc with organic top coating .
   b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.2 TYPE LFMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 360 and UL Category Control Number DXHR.

B. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Anaconda Sealtite; Anamet Electrical, Inc.
   c. Electri-Flex Company.
   d. International Metal Hose Co.
2. Material: Steel.
3. Options:
   a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.3 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL Category Control Number DZYR.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Calconduit; Atkore International.
   c. JM Eagle; J-M Manufacturing Co., Inc.
2. Dimensional Specifications: Schedule 40.
3. Options:
   a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.4 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Fittings for Type ERMC, Type IMC, and Type PVC Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Crouse-Hinds; Eaton, Electrical Sector.
   c. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   e. Southwire Company.
2. General Characteristics: UL 514B and UL Category Control Number DWTT.
3. Options:
   a. Material: Steel .
   b. Coupling Method: Compression coupling .
   c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
   d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

C. Fittings for Type EMT Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit; Atkore International.
   b. Crouse-Hinds; Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   e. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   f. Southwire Company.
2. General Characteristics: UL 514B and UL Category Control Number FKAV.
3. Options:
   a. Material: Steel .
   b. Coupling Method: Compression coupling .
   c. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.5 WIREWAYS AND AUXILIARY GUTTERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 870 and UL Category Control Number ZOYX.

B. Metal Wireways and Auxiliary Gutters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. B-line; Eaton, Electrical Sector.
   c. Hoffman; nVent.
   d. Square D; Schneider Electric USA.
   e. Wiegmann; Hubbell Incorporated, Commercial and Industrial.
2. Additional Characteristics:
   a. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
   b. Finish: Manufacturer's standard enamel finish.
3. Options:
   a. Degree of Protection: Type 1 unless otherwise indicated.
   b. Wireway Covers: Screw-cover type unless otherwise indicated.

2.6 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514A and UL Category Control Number QCIT.

B. Metallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Crouse-Hinds; Eaton, Electrical Sector.
   d. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   e. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Pass & Seymour; Legrand North America, LLC.
   g. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   h. Wiremold; Legrand North America, LLC.

i. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

3. Options:
   a. Material: Sheet steel .
   b. Sheet Metal Depth: Minimum 1.5 inch .
   c. Cast-Metal Depth: Minimum 1.8 inch .
   d. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb .
   e. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

C. Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Crouse-Hinds; Eaton, Electrical Sector.
   c. Killark; Hubbell Incorporated, Construction and Energy.
   d. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   e. Pass & Seymour; Legrand North America, LLC.
   f. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

D. Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Crouse-Hinds; Eaton, Electrical Sector.
   d. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   e. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   g. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
3. Options:
   a. Material: Sheet steel .
   b. Sheet Metal Depth: minimum 1.5 inch .
   c. Cast-Metal Depth: minimum 1.8 inch .

2.7 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514C and UL Category Control Number QCMZ.

B. Nonmetallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   d. Cantex Inc.
   e. Crouse-Hinds; Eaton, Electrical Sector.
   f. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   g. Leviton Manufacturing Co., Inc.
   h. Pass & Seymour; Legrand North America, LLC.
   i. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   j. Wiremold; Legrand North America, LLC.
   k. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

C. Nonmetallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box. Nonmetallic boxes shall be used in dwelling units ONLY.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Allied Tube & Conduit; Atkore International.
   c. Arlington Industries, Inc.
   d. Cantex Inc.
   e. Crouse-Hinds; Eaton, Electrical Sector.
   f. Pass & Seymour; Legrand North America, LLC.
   g. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   h. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2.8 CABINETS, CUTOUT BOXES, JUNCTION BOXES, AND PULL BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
   a. Non-Environmental Characteristics: UL 50.
   b. Environmental Characteristics: UL 50E.

B. Indoor Sheet Metal Cabinets:

1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.

b. B-line; Eaton, Electrical Sector.
c. Crouse-Hinds; Eaton, Electrical Sector.
d. Killark; Hubbell Incorporated, Construction and Energy.
e. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
f. Siemens Industry, Inc., Building Technologies Division.
g. Square D; Schneider Electric USA.

3. Additional Characteristics: UL Category Control Number CYIV.
4. Options:
   a. Degree of Protection: Type 1 .

2.9 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
   a. Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
   b. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Metallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   c. Crouse-Hinds; Eaton, Electrical Sector.
   d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   e. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   f. Leviton Manufacturing Co., Inc.
   g. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   h. Pass & Seymour; Legrand North America, LLC.
   i. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
   j. Wiremold; Legrand North America, LLC.
   k. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Options:
   a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
   b. Wallplate Material: Galvanized steel .

C. Nonmetallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   d. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   e. Leviton Manufacturing Co., Inc.

f. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
g. Pass & Seymour; Legrand North America, LLC.
h. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
i. Wiremold; Legrand North America, LLC.
j. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Options:
   a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
   b. Wallplate Material: 0.060 inch thick high-impact thermoplastic (nylon) with smooth finish and color matching wiring device .
   c. Color: White .

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.

B. Outdoors:

1. Exposed and Subject to Physical Damage: ERMC .
2. Concealed Aboveground: EMT .
3. Direct Buried: PVC-40.
4. Concrete Encased Not in Trench: PVC-40 .
5. Concrete Encased in Trench: PVC-40 .

C. Indoors:

1. Exposed and Subject to Physical Damage: ERMC . Subject to physical damage includes the following locations:
   a. Wall mounted raceways below 10' in unfinished areas .
2. Exposed and Not Subject to Physical Damage: EMT .
3. Concealed in Ceilings and Interior Walls and Partitions: EMT .

D. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC and IMC: Provide threaded type fittings unless otherwise indicated.

3.2 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:
   a. Type 3R unless otherwise indicated.
2. Indoors:
   a. Type 1 unless otherwise indicated.

C. Exposed Boxes Installed Less Than 10'-0" Above Floor:

1. Provide cast-metal boxes.
2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF RACEWAYS

A. Installation Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
4. Comply with NECA NEIS 101 for installation of steel raceways.
5. Comply with NECA NEIS 102 for installation of aluminum raceways.
6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
8. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts..
9. Raceway Terminations at Locations Subject to Moisture or Vibration:
   a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG..

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
3. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inch of changes in direction.
4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
6. Support conduit within 12 inch of enclosures to which attached.

7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
8. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:
   a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   b. Where an underground service raceway enters a building or structure.
   c. Conduit extending from interior to exterior of building.
   d. Conduit extending into pressurized duct and equipment.
   e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
   f. Where otherwise required by NFPA 70.
9. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
10. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
11. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
12. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:

1. Types ERMC and IMC:
   a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
2. Types FMC and LFMC:
   a. Comply with NEMA RV 3. Provide a maximum of 72 inch of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
3. Type PVC:
   a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F . Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
   b. PVC conduit shall not be installed in plenum spaces.
   c. Comply with manufacturer's written instructions for solvent welding and fittings.

D. Raceways Embedded in Slabs:

1. Arrange raceways to cross building expansion joints with expansion fittings at right angles to the joint.
2. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.

E. Stub-ups to Above Recessed Ceilings:

1. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

F. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

1. EMT: Provide compression , fittings. Comply with NEMA FB 2.10.
2. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

G. Expansion-Joint Fittings:

1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERMC conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

H. Raceways Penetrating Rooms or Walls with Acoustical Requirements:

1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

3.4 INSTALLATION OF SURFACE RACEWAYS

A. Install surface raceway with a minimum 2 inch radius control at bend points.

B. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

3.5 INSTALLATION OF BOXES AND ENCLOSURES

A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

C. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.

D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

E. Locate boxes so that cover or plate will not span different building finishes.

F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.

G. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.

H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.

I. Set metal floor boxes level and flush with finished floor surface.

J. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

K. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.

L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

M. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
2. Provide gaskets for wallplates and covers.

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING

A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Sleeve seal systems.
3. Grout.
4. Pourable sealants.
5. Foam sealants.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Wall Sleeves, Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, LLC.
   b. CCI Piping Systems.
   c. Flexicraft Industries.
2. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Pipe Sleeves, PVC:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CCI Piping Systems.
   b. GPT; an EnPro Industries company.
   c. Metraflex Company (The).
2. Description: ASTM D1785, Schedule 40.

2.2 SLEEVE SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Flexicraft Industries.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel .
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. W.R. Meadows, Inc.

B. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000 psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.4 POURABLE SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlisle SynTec Incorporated.
2. GAF.
3. Johns Manville; a Berkshire Hathaway company.

B. Description: Single-component, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.5 FOAM SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dow Chemical Company (The).
2. Innovative Chemical Products (Building Solutions Group).

B. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
   a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall and Floor Penetrations:

1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
2. Install steel pipe sleeves. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF SLEEVE SEAL SYSTEMS

A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

B. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 1000 V or Less:

1. Black letters on orange field .
2. Legend: Indicate voltage.

B. Color-Coding for Phase- Identification, 1000 V or Less: Use colors listed below for ungrounded feeder conductors.

1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
2. Colors for 208Y/120 V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
3. Colors for 240 V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
4. Color for Neutral: White .
5. Color for Equipment Grounds: Bare copper Green .
6. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

D. Equipment Identification Labels:

1. Black letters on white field.

2.3 LABELS

A. Self-Adhesive Wraparound Labels: Preprinted , 3 mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
2. Marker for Labels:
   a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
   b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:
   a. 1-1/2 by 6 inch for raceway and conductors.
   b. 3-1/2 by 5 inch for equipment.
   c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch long, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Brady Corporation.
   b. HellermannTyton.
   c. Marking Services, Inc.
   d. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Brady Corporation.
   b. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Carlton Industries, LP.
   b. Champion America.
   c. HellermannTyton.
   d. Ideal Industries, Inc.
   e. Marking Services, Inc.
   f. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. emedco.
   d. Marking Services, Inc.

C. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Brimar Industries, Inc.
   c. Ideal Industries, Inc.
   d. Marking Services, Inc.

e. Reef Industries, Inc.

2. Tape:
   a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
   b. Printing on tape must be permanent and may not be damaged by burial operations.
   c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
   a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
   b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW" .
   c. Inscriptions for Orange Tapes: "CAUTION BURIED FIBER OPTIC LINE BELOW" "CAUTION BURIED COMMUNICATION LINE BELOW" .
4. Tape Type I :
   a. Pigmented polyolefin, bright colored, compounded for direct-burial service.
   b. Width: 3 inch.
   c. Thickness: 4 mil.
   d. Weight: 18.5 lb/1000 sq. ft.
   e. Tensile in accordance with ASTM D882: 30 lbf and 2500 psi.

D. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch .

2.6 TAGS

A. Write-on Tags:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brimar Industries, Inc.
   b. Carlton Industries, LP.
   c. LEM Products Inc.
   d. Seton Identification Products; a Brady Corporation company.
2. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags:
   a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
   b. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

I. Self-Adhesive Labels:

1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.

J. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

K. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

L. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

M. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

N. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

O. Write-on Tags:

1. Place in location with high visibility and accessibility.
2. Secure using plenum-rated cable ties.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels .

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.

D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags self-adhesive labels with conductor or cable designation, origin, and destination.

E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes self-adhesive labels with conductor designation.

F. Conductors to Be Extended in Future: Attach write-on tags marker tape to conductors.

G. Workspace Indication: Apply [**or**] tape and stencil to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels .

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
   a. Power-transfer switches.
   b. Controls with external control power connections.

I. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label .

END OF SECTION 260553

SECTION 260573.13 - SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, fault-current study to determine minimum interrupting capacity of circuit protective devices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Short-Circuit Study Report:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form.
   a. Short-circuit study input data, including completed computer program input data sheets.
   b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
   c. Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.3 QUALITY ASSURANCE

A. Software algorithms must comply with requirements of standards and guides specified in this Section.

PART 2 - PRODUCTS

2.1 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kVA and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by study.

D. Comments and recommendations for system improvements or revisions in written document, separate from one-line diagram.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600 V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data:

1. One-line diagram of system being studied.
2. Power sources available.
3. Manufacturer, model, and interrupting rating of protective devices.
4. Conductors.
5. Transformer data.

G. Short-Circuit Study Output Reports:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Equivalent impedance.
2. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain data necessary for conduct of study.

B. Gather and tabulate required input data to support short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

3.2 SHORT-CIRCUIT STUDY

A. Perform study following general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 5 kA or less.
2. Exclude equipment supplied by single transformer smaller than 75 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement to address asymmetrical requirements of interrupting equipment.

H. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

I. Include in report identification of protective device applied outside its capacity.

END OF SECTION 260573.13

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electronic time switches.
2. Outdoor photoelectric switches, solid state, flexible mounting.
3. Outdoor photoelectric switches, low voltage.
4. Indoor occupancy and vacancy sensors.
5. Switchbox-mounted occupancy sensors.
6. Conductors and cables.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Intermatic, Inc.
2. Or equal with prior approval

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Contact Rating: 30 A inductive or resistive, 240 V(ac) .
3. Programs:

a. Eight on-off set points on a 24-hour schedule.
b. .

4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
5. Automatic daylight savings time changeover.
6. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Intermatic, Inc.
2. Or equal with prior approval

B. Description: Solid state, with SPST dry contacts rated for 1000 W incandescent or 1800 VA inductive , to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range , and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Failure Mode: Luminaire stays ON.

2.3 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Leviton Manufacturing Co., Inc.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. Lutron Electronics Co., Inc.
5. Sensor Switch, Inc.
6. WattStopper; Legrand North America, LLC.

B. General Requirements for Sensors:

1. WallorCeiling-mounted, solid-state indoor occupancy and vacancy sensors, as indicated on drawings.
2. Passive infrared Dual technology.
3. Separate power pack.
4. Hardwired connection to switch .

5. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
6. Operation:
   a. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
7. Power Pack: Dry contacts rated for 20 A ballast or LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
8. Mounting:
   a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
   b. Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
9. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
10. Bypass Switch: Override the "on" function in case of sensor failure.
11. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. PIR Type: Wall mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch.
2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.
3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 ft. when mounted on a 10 ft. high ceiling.

D. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Leviton Manufacturing Co., Inc.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. Lutron Electronics Co., Inc.
5. Sensor Switch, Inc.
6. WattStopper; Legrand North America, LLC.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox .

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
4. Switch Rating: Not less than 800 VA ballast or LED load at 120 V, 1200 VA ballast or LED load at 277 V, and 800 W incandescent.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION OF SENSORS

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

3.2 INSTALLATION OF WIRING

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.

C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems.

B. Label time switches and contactors with a unique designation.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Key interlock scheme drawing and sequence of operations.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1 .
   b. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, .
2. Height: 84 inches maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

F. Phase, Neutral, and Ground Buses: Tin-plated aluminum .

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum .
2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
3. Ground Lugs and Bus-Configured Terminators: type, with a lug on the bar for each pole in the panelboard.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

H. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; Schneider Electric USA.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers .

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; Schneider Electric USA.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Plug-in and Bolt-on circuit breakers, replaceable without disturbing adjacent units.

1. Plug-in circuit breakers shall be used only in dwelling unit load centers. All house and commercial tenant panelboards shall utilize bolt-on circuit breakers only.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

E. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; Schneider Electric USA.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:
   a. Inverse time-current element for low-level overloads.
   b. Instantaneous magnetic trip element for short circuits.
   c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
5. MCCB Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Breaker handle indicates tripped status.
   c. UL listed for reverse connection without restrictive line or load ratings.
   d. Lugs: style, suitable for number, size, trip ratings, and conductor materials.
   e. Ground-Fault Protection: relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
   g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
   h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder .

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Mount top of trim 90 inches above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box.

E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

H. Install filler plates in unused spaces.

I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

END OF SECTION 262416

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes work to accommodate utility company revenue meters, and Owner's electricity meters used to manage the electrical power system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For electricity-metering equipment.

1. Include elevation views of front panels of control and indicating devices and control stations.
2. Include diagrams for power, signal, and control wiring.
3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include series-combination rating data for modular meter centers with main disconnect device.

1.3 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
2. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

1.4 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and utility-furnished components.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 916.

2.2 UTILITY METERING INFRASTRUCTURE

A. Utility-Furnished Meters: Connect data transmission facility of metering equipment installed by the Utility.

B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

C. Meter Sockets:

1. Comply with requirements of electrical-power utility company.
2. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

D. Modular Meter Center: Factory-coordinated assembly of a main service disconnect device, wireways, meter socket modules, and feeder circuit breakers arranged in adjacent vertical sections complete with interconnecting buses.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton.
   b. Siemens Industry, Inc., Energy Management Division.
   c. Square D; Schneider Electric USA.
2. Comply with requirements of utility company for meter center.
   a. Comply with UL 67.
3. Housing: NEMA 250, Type 1 enclosure.
4. Meter Socket Rating: Coordinated with connected feeder circuit rating.
5. Minimum Short-Circuit Rating: 100,000 A symmetrical at rated voltage.
6. Steady-state and short-circuit current ratings shall have ratings that match connected circuit ratings.
7. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers and having an adjustable magnetic trip setting for circuit-breaker frame sizes of 250 A and larger. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers." Circuit breakers shall be operable from outside the enclosure to disconnect the unit. Configure cover so it can be opened only when the disconnect switch is open.
8. Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect downstream circuit breakers and to house load centers and panelboards that have 10,000 - A interrupting capacity.
   a. Identification: Complying with requirements in Section 260553 "Identification for Electrical Systems."

b. Physical Protection: Tamper resistant, with hasp for padlock.

9. Surge Protection for Main Disconnect: Factory installed, integrally mounted, UL 1449 Type 1. Comply with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."

E. Arc-Flash Warning Labels:

1. Labels: Comply with requirements for "Self-Adhesive Equipment Labels" and "Signs" in Section 260553 "Identification for Electrical Systems." Apply a properly sized self-adhesive label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
   a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
      1) Location designation.
      2) Nominal voltage.
      3) Flash protection boundary.
      4) Hazard risk category.
      5) Incident energy.
      6) Working distance.
      7) Engineering report number, revision number, and issue date.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install modular meter center according to switchboard installation requirements in NECA 400.

D. Wiring Method:

1. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 271513 "Communications Copper Horizontal Cabling."
3. Minimum conduit size shall be 1/2 inch.

E. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 262713

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade single straight-blade receptacles.
3. General-grade duplex straight-blade receptacles.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Toggle switches.
2. Maintained-contact switches.
3. Momentary-contact switches.
4. Rocker switches.
5. Single straight-blade receptacles
6. Duplex straight-blade receptacles.

1.3 WARRANTY FOR DEVICES

A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

A. Toggle Switch :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
   a. Reference Standards: UL CCN WMUZ and UL 20.
4. Options:
   a. Device Color: White Office White .
   b. Configuration:
      1) General-duty, 120-277 V, 15 A, single pole and three way .
      2) General-duty, 120-277 V, 20 A, single pole and three way .
5. Accessories:
   a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
   b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

A. Single Straight-Blade Receptacle :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
   a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
   a. Device Color: White .
   b. Configuration:
      1) Heavy-duty, NEMA 14-30R (Dryer) NEMA 14-50R (Range) .

5. Accessories:
   a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
   b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Tamper-Resistant Duplex Straight-Blade Receptacle :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
   a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
   a. Device Color: White .
   b. Configuration:
      1) General-duty, NEMA 5-15R in dwelling units,NEMA 5-20R in all other areas.
5. Accessories:
   a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
   b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

B. Cord Reels:

1. Examine roughing-in for cord reel mounting and power connections to verify actual locations of mounts and power connections before cord reel installation.
2. Examine walls, floors, and ceilings for suitable conditions where cord reel will be installed.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF CONTROLLED AND UNCONTROLLED RECEPTACLES

A. Private and Open Office Spaces:

1. Uncontrolled Receptacles at Workstations: Coordinate final locations of receptacles with furniture plan such that at least one uncontrolled receptacle is selected for installation not greater than 6 ft from each workstation.
2. Controlled Receptacles at Workstations: Coordinate final locations of receptacles with furniture plan such that at least one controlled receptacle is selected for installation not greater than 6 ft from each workstation.
3. Contact Architect for resolution of discrepancies between these requirements and Drawings.

3.3 SELECTION OF GFCI RECEPTACLES

A. Healthcare Facilities: Unless protection of downstream branch-circuit wiring, cord sets, and power-supply cords is required by NFPA 70 or NFPA 99, provide non-feed-through GFCI receptacles.

3.4 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Architect for resolution of conflicting requirements.

3.5 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

3.6 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

B. Cord Reels and Fittings:

1. After installation, protect cord reels and fittings from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

C. Connectors, Cords, and Plugs:

1. After installation, protect connectors, cords, and plugs from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
   a. Enclosed switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bussmann; Eaton, Electrical Sector.
2. Littelfuse, Inc.
3. Mersen USA.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 250 -V, zero- to 600-A rating, 200 kAIC , time delay.
2. Type L: 600-V, 601- to 6000-A rating, 200 kAIC , time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by .

3.2 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.3 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 240 -V ac.
4. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
5. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
3. Service-Rated Switches: Labeled for use as service equipment.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 240 -V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

END OF SECTION 262816

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
2. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

1.2 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.4 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 5 to 104 deg F.

1. Relative Humidity: Zero to 95 percent.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
   a. "USE ONLY" and include specific lamp type.
   b. Lamp diameter, shape, size, wattage, and coating.
   c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage .

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."

B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

END OF SECTION 265119

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.5 FIELD CONDITIONS

A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 1598 and listed for wet location.

C. CRI of minimum 70 . CCT as indicated on drawings. .

D. L70 lamp life of 50,000 hours.

E. Source Limitations:

1. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

C. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

D. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

E. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Wall-Mounted Luminaire Support:

1. Attached to a minimum 1/8 inch backing plate attached to wall structural members .

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

H. Coordinate layout and installation of luminaires with other construction.

I. Adjust luminaires that require field adjustment or aiming.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.2 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 265619

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding rods.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Comply with TIA-607-B.

2.2 CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Harger Lightning & Grounding.
2. Panduit Corp.
3. TE Connectivity Ltd.

B. Comply with UL 486A-486B.

C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Tray Equipment Grounding Wire: No. 6 AWG.

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
4. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Hubbell Incorporated, Construction and Energy.
2. Harger Lightning & Grounding.
3. Panduit Corp.
4. TE Connectivity Ltd.

B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

D. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.

E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Harger Lightning & Grounding.
2. Panduit Corp.

B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.

3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.5 GROUND RODS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Harger Lightning & Grounding.
2. TE Connectivity Ltd.

B. Ground Rods: Copper-clad steel ; 3/4 inch by 10 feet in diameter.

2.6 IDENTIFICATION

A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with TIA-607-B.

3.3 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

B. Underground Grounding Conductors: Install bare copper conductor, No. 4 AWG minimum.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch intervals.
4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
   a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 1/0 No. 3/0 AWG.

3.5 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pretwist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer

conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. .

3.7 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

END OF SECTION 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetallic wireways and auxiliary gutters.
5. Hooks.

1.2 ACTION SUBMITTALS

A. Product data for each type of product.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 GENERAL

A. Install communications systems cabling in conduit or cable tray where exposed. Individual or bundled cables routed in exposed ceiling areas are not acceptable.

B. Communications systems cabling may be supported by J hooks where concealed by ceilings.

2.2 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; Atkore International.
2. Allied Tube & Conduit; Atkore International.
3. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
4. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
5. Southwire Company.
6. Wheatland Tube; Zekelman Industries.

C. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

D. GRC: Comply with ANSI C80.1 and UL 6.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Fittings for EMT:
   a. Material: Steel .
   b. Type: Setscrew .
2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

G. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.3 NONMETALLIC CONDUITS AND FITTINGS

A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; Atkore International.
2. Allied Tube & Conduit; Atkore International.
3. Condux International, Inc.
4. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

C. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-D.

D. RNC: Type EPC-40-PVC , complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. Rigid HDPE: Comply with UL 651A.

F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.4 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. MonoSystems, Inc.
2. Panduit Corp.
3. Wiremold; Legrand North America, LLC.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

E. Galvanized steel.

F. J shape.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Minimum Pathway Size: 3/4-inch trade size for copper and aluminum cables, and 1 inch for optical-fiber cables.

B. Pathway Fittings: Compatible with pathways and suitable for use and location.

C. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

D. Install surface pathways only where indicated on Drawings.

E. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F .

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

G. Complete pathway installation before starting conductor installation.

H. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

I. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

J. Support conduit within 12 inches of enclosures to which attached.

K. Pathways Embedded in Slabs:

1. Run conduit parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
3. Arrange pathways to keep a minimum of 1 inch of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from nonmetallic conduit and fittings to RNC, Type EPC-40-PVC, and fittings before rising above floor.

L. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

N. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

R. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

S. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

T. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet o.c.
5. Provide a hook at each change in direction.

X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Y. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Install backfill.
2. After installing conduit, backfill and compact.
3. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete around conduit for a minimum of 12 inches on each side of the coupling.
   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
4. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.5 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

B. Related Requirements:

1. Section 270548 "Seismic Controls for Communications Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fabrication and installation details for communications hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Aluminum slotted-channel systems.
4. Nonmetallic slotted-channel systems.
5. Equipment supports.
6. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles, with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel .
3. Channel Width: 1-5/8 inches .
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
6. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M,Grade A325 .
6. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-C.
4. NECA 101.
5. NECA 105.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps .

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. Instead of expansion anchors, powder-actuated-driven threaded studs, provided with lock washers and nuts, may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
5. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor communications materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

END OF SECTION 270529

SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Pourable sealants.
3. Foam sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Pipe Sleeves, PVC:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CCI Piping Systems.
   b. GPT; an EnPro Industries company.
   c. Metraflex Company (The).
2. Description: ASTM D1785, Schedule 40.

2.2 POURABLE SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlisle SynTec Incorporated.
2. GAF.

3. Johns Manville; a Berkshire Hathaway company.

B. Description: Single-component, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.3 FOAM SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dow Chemical Company (The).
2. Innovative Chemical Products (Building Solutions Group).

B. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
   a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   b. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless sleeve seal system is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

END OF SECTION 270544

SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cable ties.
2. Miscellaneous identification products.
3. Labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70 and TIA 606-B.

B. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Brother International Corporation.
   c. HellermannTyton.
   d. Ideal Industries, Inc.
   e. Panduit Corp.
2. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Verify identity of each item before installing identification products.

C. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

D. Apply identification devices to surfaces that require finish after completing finish work.

E. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

F. Cable Ties: General purpose, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

END OF SECTION 270553

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backboards.
2. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.
2. Section 271323 "Communications Optical Fiber Backbone Cabling" for optical-fiber data cabling associated with system panels and devices.
3. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.
4. Section 271523 "Communications Optical Fiber Horizontal Cabling" for coaxial data cabling associated with system panels and devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.

B. Backboard Paint: Light-colored fire-retardant paint .

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arlington Industries, Inc.
2. Crouse-Hinds; Eaton, Electrical Sector.
3. Hoffman; nVent.

4. Hubbell Incorporated.
5. Milbank Manufacturing Co.
6. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
7. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
8. Wiremold; Legrand North America, LLC.
9. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets shall be listed and labeled for intended location and use.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, Type FD, ferrous alloy , with gasketed cover.

E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

F. Device Box Dimensions: 4 inches square by 2-1/8 inches deep .

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

G. Backboards:

1. Install from 6 inches to 8 feet, 6 inches above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
2. Paint all sides of backboard with two coats of paint.
3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

3.2 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual", "Firestopping Practices" Ch.

END OF SECTION 271100

SECTION 271116 - COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. 19-inch equipment racks.
2. Labeling.

1.2 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

B. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. UL listed.

B. RoHS compliant.

2.2 19-INCH EQUIPMENT RACKS

A. Description: four- post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch equipment mounting with an opening of 17.72-inches between rails.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chatsworth Products, Inc.
2. B-line; Eaton, Electrical Sector.
3. Belden Inc.
4. CommScope, Inc.

5. Dell Technologies Inc.
6. Leviton Manufacturing Co., Inc.
7. Panduit Corp.
8. Tripp-Lite.

C. General Requirements:

1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Material: Extruded steel .
3. Finish: Manufacturer's standard, baked-polyester powder coat.
4. Color: Black .

D. Floor-Mounted Racks:

1. Overall Height: 84 inches .
2. Overall Depth: 29 inches .
3. Upright Depth: [**3 inches**]
4. Four-Post Load Rating: 1000 lb .
5. Number of Rack Units per Rack: 45 .
6. Threads: 12-24 .
7. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug.
8. Base shall have a minimum of four mounting holes for permanent attachment to floor.
9. Top shall have provisions for attaching to cable tray or ceiling.
10. Self-leveling.

E. Cable Management:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.3 LABELING

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout of communications equipment spaces.

C. Comply with BICSI ITSIMM for installation of communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in racks and room. Coordinate service entrance configuration with service provider.

1. Meet jointly with system providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment spaces to accommodate and optimize configuration and space requirements of telecommunications equipment.
4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 IDENTIFICATION

A. Coordinate system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 270553 "Identification for Electrical Systems."

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.

D. Labels shall be machine printed. Type shall be 1/8 inch in height.

END OF SECTION 271116

SECTION 271323 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. 62.5/125-micrometer, multimode, optical fiber cable (OM1).

1.2 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics including the following:
    a. Telecommunications rooms plans and elevations.
    b. Telecommunications pathways.
    c. Telecommunications system access points.
    d. Cross-connects.
    e. Patch panels.
    f. Patch cords.
5. Cross-connects and patch panels.

1.4 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

2.2 62.5/125-MICROMETER, MULTIMODE, OPTICAL FIBER CABLE (OM1)

A. Description: Multimode, 62.5/125-micrometer, [**24**] -fiber, nonconductive, tight buffer, optical fiber cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden, Inc.
2. CommScope, Inc.
3. General Cable; Prysmian Group North America.
4. Mohawk; a division of Belden Networking, Inc.
5. Superior Essex Inc.

C. Standards:

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAA for detailed specifications.

D. Conductive cable shall be steel armored type.

E. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

F. Minimum Overfilled Modal Bandwidth-length Product: 200 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

G. Jacket:

1. Jacket Color: Orange .
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

H. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Riser Rated, Nonconductive: Type OFNR , complying with UL 1666.

2.3 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Technology Systems Industries, Inc.
2. Belden, Inc.
3. CommScope, Inc.
4. Dynacom Corporation.

B. Standards:

1. Comply with Optical Fiber Connector Intermateability Standard specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

2.4 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot- long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 1 .
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.

C. Comply with requirements in Section 271523 "Communications Optical Fiber Horizontal Cabling" for cable and asset management software.

D. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

END OF SECTION 271323

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Cable management system.

1.2 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules:
   a. Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration Drawings and printouts.
3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment.

1.4 QUALITY ASSURANCE

1.5 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated:
   a. Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway .

B. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.

B. Manufacturers: Subject to compliance with requirements, undefined:

1. AMP NETCONNECT; a TE Connectivity Ltd. company.
2. Belden, Inc.
3. CommScope, Inc.
4. General Cable; Prysmian Group North America.
5. Genesis Cable Products; Honeywell International, Inc.
6. Mohawk; a division of Belden Networking, Inc.
7. Superior Essex Inc.
8. SYSTIMAX Solutions; a CommScope Inc. brand.

C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP) .

F. Cable Rating: Plenum.

G. Jacket: Blue thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMP NETCONNECT; a TE Connectivity Ltd. company.
2. Belden, Inc.
3. CommScope, Inc.
4. General Cable; Prysmian Group North America.
5. Genesis Cable Products; Honeywell International, Inc.
6. Mohawk; a division of Belden Networking, Inc.
7. Superior Essex Inc.
8. SYSTIMAX Solutions; a CommScope Inc. brand.

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6 .
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.

E. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:
   a. Universal T568A and T568B wiring labels.
   b. Labeling areas adjacent to conductors.
   c. Replaceable connectors.
   d. 24 or 48 ports.
2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
3. Number of Jacks per Field: One for each four-pair cable indicated .

F. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

G. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568-C.2.
3. Marked to indicate transmission performance.

H. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or cover plate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.

I. Cover Plate:

1. Plastic Cover Plate: High-impact plastic. Coordinate color with Section 260533 "Raceway and Boxes for Electrical Systems."
2. Metal Cover Plate: , complying with requirements in Section 260533 "Raceway and Boxes for Electrical Systems."
3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
   a. Flush mounting jacks, positioning the cord at a 45-degree angle.

PART 3 - EXECUTION

3.1 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. Routing: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

D. General Requirements for Cabling:

1. Comply with TIA-568-C.1.
2. Comply with BICSI's Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
11. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.

3.2 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.3 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

C. Comply with TIA-607-B and NECA/BICSI-607.

D. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

E. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.

C. Equipment grounding conductors.

D. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

E. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.5 MAINTENANCE

END OF SECTION 271513

SECTION 271523 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. 62.5/125-micrometer, multimode, optical fiber cable (OM1).

1.2 OPTICAL FIBER HORIZONTAL CABLING DESCRIPTION

A. Optical fiber horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C and the equipment outlet, otherwise known as "Cabling Subsystem 1," or Distributor C and the equipment outlet, otherwise known as "Centralized Cabling," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration Drawings and printouts.
4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 62.5/125-MICROMETER, MULTIMODE, OPTICAL FIBER CABLE (OM1)

A. Description: Multimode, 62.5/125-micrometer, 1 -fiber, nonconductive , tight buffer, optical fiber cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden, Inc.
2. Berk-Tek Leviton; a Nexans/Leviton alliance.
3. CommScope, Inc.
4. General Cable; Prysmian Group North America.
5. Mohawk; a division of Belden Networking, Inc.
6. Superior Essex Inc.

C. Standards:

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAA for detailed specifications.

D. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

E. Minimum Overfilled Modal Bandwidth-length Product: 200 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

F. Jacket:

1. Jacket Color: Orange .
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

G. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

PART 3 - EXECUTION

3.1 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301 and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot- long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

D. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

E. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

F. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

G. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

H. Group connecting hardware for cables into separate logical fields.

3.2 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.3 GROUNDING

A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

D. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

END OF SECTION 271523

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Addressable fire-alarm system.
2. Fire-alarm control unit (FACU).
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Heat detectors.
6. Multicriteria and multisensor fire detectors.
7. Fire-alarm notification appliances.
8. Fire-alarm remote annunciators.
9. Fire-alarm addressable interface devices.
10. Digital alarm communicator transmitters (DACTs).

B. Related Requirements:

1. Section 087100 "Door Hardware" for magnetic door holders that release in response to fire-alarm outputs.
2. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" or Section 260523 "Control Voltage Electrical Power Cables" for cables and conductors for fire-alarm systems.

1.2 DEFINITIONS

A. DACT: Digital alarm communicator transmitter.

B. FACU: Fire-alarm control unit.

C. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.3 ACTION SUBMITTALS

A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.

B. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

C. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, and details, including details of attachments to other Work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Annunciator panel details as required by authorities having jurisdiction.
5. Detail assembly and support requirements.
6. Include voltage drop calculations for notification-appliance circuits.
7. Include battery-size calculations.
8. Include input/output matrix.
9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
10. Include performance parameters and installation details for each detector.
11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
12. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
    c. Locate detectors in accordance with manufacturer's written instructions.
13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

D. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
2. Installation must be by personnel certified by NICET as fire-alarm Level III technician.
3. Obtain certification by NRTL in accordance with NFPA 72.
4. Licensed or certified by authorities having jurisdiction.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ADDRESSABLE FIRE-ALARM SYSTEM

A. Description:

1. Noncoded, addressable system, with multiplexed signal transmission and horn-and-strobe notification for evacuation.

B. Performance Criteria:

1. Regulatory Requirements:
   a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.
2. General Characteristics:
   a. Automatic sensitivity control of certain smoke detectors.
   b. Fire-alarm signal initiation must be by one or more of the following devices:
      1) Manual stations.
      2) Heat detectors.
      3) Smoke detectors.
      4) Automatic sprinkler system water flow.
      5) Fire pump running.
      6) .
   c. Fire-alarm signal must initiate the following actions:
      1) Identify alarm and specific initiating device at FACU and remote annunciators.
      2) Transmit alarm signal to remote alarm receiving station.
      3) Unlock electric door locks in designated egress paths.
      4) Switch HVAC equipment controls to fire-alarm mode.
      5) Recall elevators to primary or alternate recall floors.
      6) Activate elevator power shunt trip.
      7) Record events in system memory.
      8) .

d. Supervisory signal initiation must be by one or more of the following devices and actions:
   1) Valve supervisory switch.
   2) Elevator shunt-trip supervision.
   3) Fire pump is running.
   4) Fire pump has lost power.
   5) .

e. System trouble signal initiation must be by one or more of the following devices and actions:
   1) Open circuits, shorts, and grounds in designated circuits.
   2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
   3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
   4) Loss of primary power at FACU.
   5) Ground or single break in internal circuits of FACU.
   6) Abnormal ac voltage at FACU.
   7) Break in standby battery circuitry.
   8) Failure of battery charging.
   9) Abnormal position of switch at FACU or annunciator.
   10) .

f. System Supervisory Signal Actions:
   1) Identify specific device initiating event at FACU and remote annunciators.
   2) After time delay of 200 seconds , transmit trouble or supervisory signal to remote alarm receiving station.
   3) Display system status on graphic annunciator.

g. Document Storage Box:
   1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
   2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
   3) Color: Red powder-coat epoxy finish.
   4) Labeling: Permanently screened with 1 inch high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
   5) Security: Locked with 3/4 inch barrel lock. Provide solid 12 inch stainless steel piano hinge.

2.2 FIRE-ALARM CONTROL UNIT (FACU)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Edwards; Carrier Global Corporation.
2. Fire-Lite Alarms; Honeywell International, Inc.
3. Gamewell-FCI; Honeywell International, Inc.
4. Notifier; Honeywell International, Inc.
5. Siemens Industry, Inc., Building Technologies Division.
6. Silent Knight; Honeywell International, Inc.

7. Simplex; Johnson Controls.

B. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.

C. Performance Criteria:

1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
2. General Characteristics:
   a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
   b. Include real-time clock for time annotation of events on event recorder and printer.
   c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
   d. FACU must be listed for connection to central-station signaling system service.
   e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
   f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
      1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
   g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
      1) Annunciator and Display: LCD, 160 characters, minimum.
      2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
   h. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
      1) Pathway Class Designations: NFPA 72, Class A .
      2) Pathway Survivability: Level 0 .
   i. Notification-Appliance Circuit:
      1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
      2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
      3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
   j. Elevator Recall: Initiate by one of the following alarm-initiating devices:
      1) Elevator lobby detectors except lobby detector on designated floor.
      2) Smoke detectors in elevator machine room.
      3) Smoke detectors in elevator hoistway.
   k. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.

l. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.
   1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.

m. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.

n. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
   1) Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
   2) Programmable tone and message sequence selection.
   3) Standard digitally recorded messages for "Evacuation" and "All Clear."
   4) Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of FACU.

o. Status Annunciator: Indicate status of various voice/alarm speaker zones and status of firefighters' two-way telephone communication zones.

p. Preamplifiers, amplifiers, and tone generators must automatically transfer to backup units, on primary equipment failure.

q. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate printing of list of existing alarm, supervisory, and trouble conditions in system and historical log of events.

r. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals supervisory and DACT must be powered by 24 V(dc) source.

s. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.

t. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.

D. Accessories:

1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.

2.3 MANUAL FIRE-ALARM BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Edwards; Carrier Global Corporation.
2. Fire-Lite Alarms; Honeywell International, Inc.
3. Gamewell-FCI; Honeywell International, Inc.
4. Notifier; Honeywell International, Inc.
5. Siemens Industry, Inc., Building Technologies Division.
6. Silent Knight; Honeywell International, Inc.
7. Simplex; Johnson Controls.

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm. Lifting cover actuates integral battery-powered audible horn intended to discourage false-alarm operation.
4. Able to perform at up to 90 percent relative humidity at 90 deg F .
5. Able to be used in indoor areas.

2.4 SYSTEM SMOKE DETECTORS

A. Photoelectric Smoke Detectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Edwards; Carrier Global Corporation.
   b. Fire-Lite Alarms; Honeywell International, Inc.
   c. Gamewell-FCI; Honeywell International, Inc.
   d. Gentex Corporation.
   e. Notifier; Honeywell International, Inc.
   f. Siemens Industry, Inc., Building Technologies Division.
   g. Silent Knight; Honeywell International, Inc.
   h. Simplex; Johnson Controls.
2. Performance Criteria:
   a. Regulatory Requirements:
      1) NFPA 72.
      2) UL 268.
   b. General Characteristics:
      1) Detectors must be two-wire type.
      2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
      3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
      4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
   a) Primary status.
   b) Device type.
   c) Present average value.
   d) Present sensitivity selected.
   e) Sensor range (normal, dirty, etc.).
8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
9) Color: White .
10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
11) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
12) Sensitivity levels based on time of day.

2.5 HEAT DETECTORS

A. Fixed-Temperature-Type Heat Detectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Edwards; Carrier Global Corporation.
   b. Fire-Lite Alarms; Honeywell International, Inc.
   c. Gamewell-FCI; Honeywell International, Inc.
   d. Gentex Corporation.
   e. Notifier; Honeywell International, Inc.
   f. Siemens Industry, Inc., Building Technologies Division.
   g. Silent Knight; Honeywell International, Inc.
   h. Simplex; Johnson Controls.
2. Performance Criteria:
   a. Regulatory Requirements:
      1) NFPA 72.
      2) UL 521.
   b. General Characteristics:
      1) Actuated by temperature that exceeds fixed temperature of 190 deg F .
      2) Mounting: Twist-lock base interchangeable with smoke-detector bases.
      3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
      4) Detector must have functional humidity range of 10 to 90 percent.
      5) Color: White .

2.6 FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Audible Notification Appliances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Edwards; Carrier Global Corporation.
   b. Gentex Corporation.
   c. Notifier; Honeywell International, Inc.
   d. Siemens Industry, Inc., Building Technologies Division.
   e. Simplex; Johnson Controls.
2. Description: Horns, bells, or other notification devices that cannot output voice messages.
3. Performance Criteria:
   a. Regulatory Requirements:
      1) NFPA 72.
   b. General Characteristics:
      1) Individually addressed, connected to signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
      2) Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
      3) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured 10 ft. from horn, using coded signal prescribed in UL 464 test protocol.
      4) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Fire-Alarm Visible Notification Appliances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Edwards; Carrier Global Corporation.
   b. Gentex Corporation.
   c. Notifier; Honeywell International, Inc.
   d. Siemens Industry, Inc., Building Technologies Division.
   e. Simplex; Johnson Controls.
2. Performance Criteria:
   a. Regulatory Requirements:
      1) NFPA 72.
      2) UL 1971.
   b. General Characteristics:
      1) Rated Light Output:
         a) 15/30/75/110 cd, selectable in field.
      2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
      3) Mounting: Wall or ceiling mounted as indicated on drawings.
      4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
      5) Flashing must be in temporal pattern, synchronized with other units.
      6) Strobe Leads: Factory connected to screw terminals.

7) Mounting Faceplate: Factory finished, white.

2.7 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Notifier; Honeywell International, Inc.

B. Performance Criteria:

1. Regulatory Requirements:
   a. NFPA 72.
2. General Characteristics:
   a. Include address-setting means on module.
   b. Store internal identifying code for control panel use to identify module type.
   c. Listed for controlling HVAC fan motor controllers.
   d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
   e. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown .
      1) Allow control panel to switch relay contacts on command.
      2) Have minimum of two normally open and two normally closed contacts available for field wiring.
   f. Control Module:
      1) Operate notification devices.
      2) Operate solenoids for use in sprinkler service.
      3) .

2.8 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Edwards; Carrier Global Corporation.

B. Performance Criteria:

1. Regulatory Requirements:
   a. NFPA 72.
2. General Characteristics:
   a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.
   b. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically capture one telephone line(s) and dial preset number for remote central station. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of telephone line to remote alarm receiving station over remaining

line. Transmitter must automatically report telephone service restoration to central station. If service is lost on both telephone lines, transmitter must initiate local trouble signal.

c. Local functions and display at DACT must include the following:
   1) Verification that both telephone lines are available.
   2) Programming device.
   3) LED display.
   4) Manual test report function and manual transmission clear indication.
   5) Communications failure with central station or FACU.
   6) .

d. Digital data transmission must include the following:
   1) Address of alarm-initiating device.
   2) Address of supervisory signal.
   3) Address of trouble-initiating device.
   4) Loss of ac supply.
   5) Loss of power.
   6) Low battery.
   7) Abnormal test signal.
   8) Communication bus failure.

e. Secondary Power: Integral rechargeable battery and automatic charger.

f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.

B. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 INSTALLATION OF EQUIPMENT

A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before other trades have completed cleanup must be replaced.
2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
2. Mount manual fire-alarm box on background of contrasting color.
3. Operable part of manual fire-alarm box must be between 42 and 48 inch above floor level. Devices must be mounted at same height unless otherwise indicated.

D. Smoke- and Heat-Detector Spacing:

1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing must not exceed 30 ft. .
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inch from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inch from lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch long must be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

H. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.

K. Device Location-Indicating Lights: Locate in public space near device they monitor.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 PATHWAYS

A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inch above floor must be installed in EMT.

B. Pathways must be installed in EMT.

C. Exposed EMT must be painted red enamel.

3.7 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
3. Smoke dampers in air ducts of designated HVAC duct systems.
4. Electronically locked doors and access gates.
5. Alarm-initiating connection to elevator recall system and components.
6. Alarm-initiating connection to activate emergency lighting control.
7. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
8. Supervisory connections at valve supervisory switches.
9. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
10. Supervisory connections at elevator shunt-trip breaker.
11. Data communication circuits for connection to building management system.
12. Data communication circuits for connection to mass notification system.
13. Supervisory connections at fire-extinguisher locations.
14. Supervisory connections at fire-pump power failure including dead-phase or phase-reversal condition.
15. Supervisory connections at fire-pump engine control panel.
16. .

3.8 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Install framed instructions in location visible from FACU.

3.9 GROUNDING

A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.10 FIELD QUALITY CONTROL

A. Field tests must be witnessed by authorities having jurisdiction .

B. Administrant for Tests and Inspections:

1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
   a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
   b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 284621.11

SECTION 312113 RADON MITIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all work necessary to design and install a passive mitigation system to reduce and maintain indoor radon concentration levels below 4.0 picoCuries per liter (pCi/L) as specified herein and as needed for a complete and proper installation including but not limited to:

1. Pre-mitigation radon testing.
2. Complete radon mitigation design, construction drawings, and installation, meeting the approval of the Owner, Contractor, Architect, and all governmental agencies having jurisdiction.
3. Post mitigation radon testing.

B. Related Requirements: Provide inspections and testing in accordance with applicable U.S. Environmental Protection Agency (EPA) and ASTM International (ASTM) standards.

1.2 QUALITY ASSURANCE

A. Radon Mitigation system Provider Qualifications:

1. Provider to meet the standards of the National Environmental Health Association (NEHA) and the National Radon Safety Board (NRSB) for radon mitigation service providers.
2. Provider to be authorized to operate in the state of Missouri.
3. System design to meet basic requirements of ASTM E1465, “Standard Practice for Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings.”
4. Equipment used in performing diagnostic testing to be calibrated at reasonable intervals by devices of accuracy traceable to either:

    a. National Bureau of Standards.
    b. Accepted values of natural physical constants.

1.3 DESIGN AND TESTING REQUIREMENTS

A. Design Requirements:

1. Prepare design, construction and installation drawings and assemble and provide product data for construction of a passive radon mitigation system for each building. Provide plans and details indicating suction points and routing of piping to the exterior of the building. Indicate pipe sizes for each system.
2. Prepare design narrative supporting the system design indicated in the design, construction and installation drawings. Indicate radon mitigation chosen to reduce radon concentrations below specified levels. Provide data and calculations to verify negative pressure exists throughout the soil gas to the atmosphere under all weather

and building operating conditions.

B. Testing Requirements:

1. Perform pre-mitigation testing to determine existing radon levels.
2. Perform post mitigation radon testing in all buildings upon completion of installation of radon mitigation system. Verify radon levels are at concentrations below specified levels. Provide data, reports and logs documenting radon test results in all buildings.
3. Post mitigation test results indicating concentrations above specified radon levels will require system modifications by the mitigation system provider to achieve results below these levels.

1.4 SUBMITTALS

A. Provide complete construction and installation drawings and submittals, prepared by the certified radon mitigation provider, for review and approval of the Owner, Contractor, Architect, and all governmental agencies having jurisdiction. Submittals shall include:

1. Certification of radon mitigation system provider's qualifications.
2. Radon mitigation system construction and installation drawings.
3. Product data for system components.
4. Design narrative supporting the system design indicated in the construction and installation drawings.
5. Test reports indicating pre-mitigation and post mitigation radon levels.
6. System Maintenance data.
7. As-built drawings indicating variations, if any, between the construction drawings and actual system installation.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Radon mitigation systems shall reduce and maintain radon concentration levels below 4.0 picoCuries per liter (pCi/L) at all buildings after installation of mitigation systems.

2.2 SYSTEM COMPONENTS

A. Poly Vinyl Chloride (PVC) Piping: ASTM D2665, Schedule 40, size to be determined by system design requirements.

B. Gravel: 1/2" to 3/4" clean, with no fines.

C. Vapor Retarder: Se Section 033000 for vapor retarder sheeting.

D. Accessories: Provide sealants, fittings and flashings required for the installation of a complete system.

PART 3 - EXECUTION

3.1 SYSTEM INSTALLATION

A. Provide radon mitigation systems as indicated in the approved design drawings and as required by the specifications and standards referenced herein.

B. Install piping plumb and parallel to enclosure walls, partitions and ceilings, and secure in place in a rigid and substantial manor.

C. Seal and firestop all penetrations, cracks and openings around floor and wall penetrations. Insure all penetrations to the building exterior are weathertight.

D. Layout all work in advance. Exercise care where cutting, channeling, chasing or drilling floors, walls, partitions, ceilings or other surfaces as necessary for proper installation, support or anchorage. Patch and repair any damage using skilled workmen in the trade involved.

3.2 FIELD QUALITY CONTROL

A. Supervision: Installation of the system shall be supervised by a certified radon mitigation system provider.

B. Inspection: All systems shall be inspected by a certified radon mitigation system provider. Verify all penetrations are sealed and firestopped. Deficiencies shall be corrected by the mitigation system provider.

C. Post Mitigation Testing: Prior to building occupancy, perform post mitigation radon testing in all buildings as specified herein.

3.3 ADJUSTMENTS

A. Where post mitigation testing indicates concentrations above 4.0 picoCuries per liter (pCi/L), modify the system as require to achieve results below these levels prior to building occupancy.

3.4 MAINTENANCE

A. Provide maintenance data and instruct the Owner’s personnel in the proper maintenance of all installed systems.

3.5 AS-BUILT DRAWINGS

A. Provide as-built drawings documenting any variations between construction and installation drawings and actual system installation.

END OF SECTION 312113

SECTION 312513 TEMPORARY EROSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Perimeter erosion protection.
2. Curb inlet erosion protection.

B. Related Sections:

1. Section 311000 - Site Clearing.
2. Section 312000 - Earthwork.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements;

1. Comply with all requirements, exemptions, regulations and outflow sampling requirements set forth by local and state agencies.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Silt Fence or other perimeter erosion control devices shall be in accordance with City of Parkville and KC Metro APWA requirements.

B. Inlet erosion protection shall be block and gravel devices or gravel filter bags as indicated on the drawings or a synthetic filter manufactured from recycled synthetic fibers. The curb inlet protection will be manufactured to be 9” in diameter and are available in 4’, 6’, 8’, 10’, 12’, 14’, and 16’ lengths and a minimum of twenty-four (24) inches longer than the curb opening. This will allow for sufficient length to cover the inlet with twelve (12) inches beyond the inlet on both ends. It shall meet the following requirements:

1. Reduction in Total Suspended Solids: Not less than 85 percent.
2. Reduction in Hydrocarbons: Not less than 85 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper and timely completion:

1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection:

1. Protect trees, shrubs, lawns, other vegetation and other features indicated on Drawings to remain, or not indicated to be removed.

a. Provide temporary guards to protect trees and vegetation which is to remain.
b. Protect roots over 1-1/2 inch diameter which are cut during construction operations.

1) Coat cut faces with emulsified asphalt or other acceptable coating formulated for use on damaged plan tissues.
2) Temporarily cover exposed roots with wet burlap to prevent roots from drying out. Cover with earth as soon as possible.

2. Protect bench marks, monuments, existing structures, existing fences, existing roads, existing sidewalks, existing paving, existing curbs and other features indicated on Drawings to remain, or not indicated to be removed, from damage and displacement.

c. If damaged or displaced, notify Engineer and correct defects as directed by Engineer.

3. Protect above and below grade utilities which are to remain.

B. Preparation:

1. Use all means necessary to control dust on and near the Work, and on and near off-site storage, and spoil areas, if such dust is caused by performance of the Work of this Section, or if resulting from the condition in which Project Site is left by Contractor.
2. Moisten surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other Work on Project Site.

3.3 INSTALLATION

A. Install erosion control devices at locations indicated on Drawings, and where required to protect adjacent and downstream properties from damage and pollution resulting from erosion caused by the Work of this Contract.

1. Implement erosion control measures indicated on Drawings and additional erosion control measures necessary to prevent damage to adjacent and downstream properties.

B. Install silt fence or other approved erosion control device located along perimeter of Site or grading limits prior to commencing site clearing operations specified under Section 311000.

1. Install perimeter erosion control device as shown on drawings.

C. Install inlet protection prior to disturbing affected area.

1. Install the inlet protection in front of the inlet opening. Each end of the inlet protection should overlap the inlet approximately 12”.

3.4 MAINTENANCE

A. Check perimeter erosion control devices and inlet protection after each rainfall event to ensure that they are in proper working order:

1. Immediately make all necessary repairs.

B. Inspect erosion control at least once a week.

1. Immediately replace damaged portions of the erosion control devices, including portions which have collapsed, have decomposed, or have become ineffective.

C. Remove sediment deposits as necessary to provide adequate sediment storage and to maintain the integrity of fences. Ponding is likely if sediment is not removed regularly.

D. Maintain erosion control devices in places as specified until Site is stabilized by pavement, vegetation, or other means.

E. After site is stabilized, remove erosion control devices, sediment, and debris from Site.

END OF SECTION 312513

SECTION 313116 TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Soil treatment with termiticide.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the EPA-Registered Label for termiticide products.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Soil Treatment Application Report: Include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

C. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.

B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

C. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.6 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Subject to compliance with requirements, provide Bayer Environmental Science, Premise 75, or approved equal, termite control.

2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.2 APPLYING SOIL TREATMENT

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

C. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to

be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

D. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Masonry: Treat voids.
3. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

E. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

F. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

G. Post warning signs in areas of application.

H. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 313116

SECTION 321813 - SYNTHETIC GRASS SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes synthetic grass surfacing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For synthetic grass surfacing.

1. Include sections and details.
2. Show locations of seams and method of seaming.
3. Show location and layout of team logo/graphics.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For synthetic grass surfacing, including maintenance cleaning instructions, to include in maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Turf Fabric: Minimum of 300 sq. ft. for each type indicated.
2. Infill: Minimum of two bags of each type.
3. Seaming Tape and Adhesive: One roll of seaming tape and one gallon of adhesive.
4. One new set of maintenance tools, of type recommended by synthetic grass surfacing manufacturer for installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials in location and manner to allow installation of synthetic grass surfacing without excess disturbance of granular base.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace synthetic grass surfacing that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration and excessive wear.
b. Deterioration from UV light.
c. Excessive loss of shock attenuation.
d. Seam separation.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Turf Fabric: Turf fabric tested according to the following methods, with additional test method conditions for each method according to ASTM F1551.

1. Tuft Bind: Not less than 8 lbf according to ASTM D1335.
2. Breaking Strength: Minimum 200 lbf in warp direction and minimum 200 lbf perpendicular to warp direction, according to ASTM D5034.

B. Synthetic Grass Surfacing: Assembly tested according to the following methods, with additional test method conditions for each method according to ASTM F1551.

C. Permeability: 1,400 in./h of rainfall capacity according to ASTM F2898 or EN 15330-1.

2.2 SYNTHETIC GRASS SURFACING

A. Synthetic Grass Surfacing: Complete surfacing system, consisting of synthetic yarns bound to water-permeable backing and infill indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. SYNLawn.

B. Locations and Products:

1. Pet Patios: SYNLawn PET Premium.

C. Turf Fabric: Woven turf fabric with multicolored fiber and UV resistance, complying with the following:

1. Yarn Fiber: Polyethylene.

D. Backing: Manufacturer's standard woven or nonwoven polypropylene primary backing with urethane-coated secondary backing; provide perforations or drainage channels sufficient to meet permeability indicated.

E. Infill: Manufacturer's standard sand and rubber infill.

1. Infill Proportions: Manufacturer's standard proportions.

F. Seaming Method: Adhesive.

2.3 MATERIALS

A. Rubber Infill: Ground latex-coated SBR crumb rubber mesh free of metal, nonmetal fibers, and contaminants; mesh size as recommended by synthetic grass surfacing manufacturer.

B. Sand Infill: Uniformly sized latex-coated silica sand free of silts, clays, and contaminants, and of subangular or rounder shape according to ASTM F1632; mesh size as recommended by synthetic grass surfacing manufacturer.

C. Seam Adhesive: One- or two-part urethane, recommended or approved by synthetic grass surfacing manufacturer, and suitable for ambient conditions at time of installation.

D. Seam Tape: Synthetic grass manufacturer's recommended seam tape, minimum 12 inches wide.

E. Shock-Attenuation Pad: Porous composite consisting of rubber granules bound with urethane adhesive, 5 mm thick. Provide shock-attenuation pad with permeability sufficient to meet synthetic grass surfacing assembly permeability indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine base and other conditions, with Installer present, for compliance with requirements for installation tolerances, permeability, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Avoid disturbance of base during installation of shock-attenuation pad and turf fabric.

B. Shock-Attenuation Pad Installation: Roll out pad and allow to relax a minimum of six hours prior to final fit and trim. Stagger head seams between adjacent rows. Fit seams snugly without stretching or forcing.

C. Roll out turf fabric and allow to relax at least four hours prior to seaming.

D. Provide seams flat and snug, with no gaps or fraying. Remove yarns that are trapped within seams. Attach turf fabric to perimeter restraint system as recommended by the manufacturer.

E. Repair loose seams and bubbles formed due to expansion of turf fabric prior to installation of infill.

F. Evenly broadcast and groom infill by machine in proportions and depth after settling as recommended by the manufacturer, and to meet indicated performance requirements. Rake fibers trapped by infill to surface.

3.3 DEMONSTRATION

A. Train Owner's maintenance personnel in proper maintenance procedures for synthetic grass surfacing.

END OF SECTION 321813

SECTION 323119 DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative steel fences, factory painted.
2. Swing gates for pedestrian walkways with closers and latches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For gates. Include plans, elevations, sections, details, and attachments to other work.

1. Include diagrams for power, signal, and control wiring.

C. Samples: For each fence material and for each color specified.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Product Test Reports: For decorative metallic-coated-steel tubular picket fences, including finish, indicating compliance with referenced standard and other specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For gate operators to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DECORATIVE STEEL AND IRON

A. Decorative steel and iron fences for Site Fencing:

1. Ameristar Fence, Tulsa, Oklahoma, Montage Plus® design, welded and rackable (ATF All Terrain Flexibility) Ornamental Steel Majestic™ design, three-rail style. System shall include all components (i.e., panels, posts, gates and hardware, including power operated gates for all automotive gates, with remote wireless operation) required.

B. Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.

1. Pickets shall be ¾" square x 18 Ga. tubing, with Rails of steel channel, 1/5" x 1/4375" x 14 Ga. Picket holes in the rail shall be spaced (4.675"o.c. for standard picket space)

D. Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

E. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 50 (Grade 340), with G90 (Z275) coating.

F. Aluminum-Zinc, Alloy-Coated Steel Sheet: ASTM A 792/A 792M, structural quality, Grade 50 (Grade 340), with AZ60 (AZM180) coating.

G. Fence posts shall be 2-1/2" x 16 Ga. min. up to 6' high, with max spacing of nominal 8' in width

H. Gate leafs up to 4' wide and 6' in height, shall be 3" x 12 Ga. min for gate posts.

2.2 SWING GATES

A. Gate Configuration: Single leaf.

B. Gate Opening Width: 36 inches, unless otherwise indicated.

C. Infill: Comply with requirements for adjacent fence.

D. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.

E. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet wide.

F. Spring Hinges: BHMA A156.17, Grade 1, suitable for exterior use.

1. Function: Gate spring hinge. Adjustable tension.

G. Exit Hardware: BHMA A156.3, Grade 1, Type 1 (rim exit device), with push pad actuating bar, suitable for exterior use.

1. Function: 09 - Entrance by lever only when released by key. Key removable only when locked.
2. Mounting Channel: Bent-plate channel formed from 1/8-inch- thick, steel plate. Channel spans gate frame. Exit device is mounted on channel web, recessed between flanges, with flanges extending 1/8 inch beyond push pad surface

2.3 COATING MATERIALS

A. Epoxy Primer for Galvanized Steel: Epoxy primer recommended in writing by topcoat manufacturer.

B. Intermediate Coat for Uncoated Steel: Epoxy or polyurethane intermediate recommended in writing by primer and topcoat manufacturer.

C. Polyurethane Intermediate Coat and Topcoat: Complying with MPI #72 and compatible with undercoat.

D. Finished color, Black.

2.4 MISCELLANEOUS MATERIALS

A. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 4000 psi, 3-inch (75-mm) slump, and 1-inch (25-mm) maximum aggregate size.

2.5 GROUNDING MATERIALS

A. Grounding Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

1. Material above Finished Grade: Aluminum.
2. Material on or below Finished Grade: Copper.

B. Grounding Connectors and Grounding Rods: Comply with UL 467.

2.6 STEEL FINISHES

A. Surface Preparation: Clean surfaces according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

1. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.

B. Powder Coating: Immediately after cleaning, apply two-coat finish consisting of epoxy primer and TGIC polyester topcoat, with a minimum total dry film thickness of not less than 8 mils (0.20 mm). Comply with coating manufacturer's written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

C. Primer Application: Apply zinc-rich epoxy primer immediately after cleaning, to provide a minimum dry film thickness of 2 mils (0.05 mm) per applied coat, to surfaces that are exposed after assembly and installation, and to concealed surfaces.

D. High-Performance Coating: Apply intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

2.7 METALLIC-COATED-STEEL FINISHES

A. Galvanized Finish: Clean welds, mechanical connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a zinc-phosphate conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

C. Ameristar Fence Products standard 20 year finish coating, as described above or equal or better

D. High-Performance Coating: Apply epoxy primer, polyurethane intermediate coat, and polyurethane topcoat to prepared surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

PART 3 - EXECUTION

3.1 DECORATIVE FENCE INSTALLATION

A. Install fences according to manufacturer's written instructions.

B. Install fences by setting posts as indicated and fastening rails and infill panels to posts. Peen threads of bolts after assembly to prevent removal.

C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches (600 mm) plus 3 inches (75 mm) for each foot (300 mm) or fraction of a foot (300 mm) that fence height exceeds 4 feet (1.2 m).

D. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
3. Posts Set in Concrete: Extend post to within 6 inches (150 mm) of specified excavation depth, but not closer than 3 inches (75 mm) to bottom of concrete.
4. Space posts uniformly at 8 feet (2.44 m)o.c.

3.2 GROUNDING AND BONDING

A. Fence Grounding: Install at maximum intervals of 1500 feet (450 m) except as follows:

1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of (225 m).

    a. Gates and Other Fence Openings: Ground fence on each side of opening. Bond metal gates to gate posts.

B. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location. At areas above grade, ground per NEC current requirements.

C. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

D. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

E. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.

END OF SECTION 323119

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. These specifications are the minimum required. Regulatory Authority's rules, regulations, and specifications apply to this section.

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service, fire-service mains, and combined water service and fire-service mains.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene terpolymer rubber.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PA: Polyamide (nylon) plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1. Wiring Diagrams: Power, signal, and control wiring for alarms.

C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

G. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping.
2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of service.

2. Do not proceed with interruption of water-distribution service without Architect's written permission.

1.8 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A).

1. Copper, Pressure-Seal Fittings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Viega; Plumbing & Heating Systems.
2) Or Equal.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

C. Flanges: ASME 16.1, Class 125, cast iron.

2.3 PVC PIPE AND FITTINGS

A. PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.
2. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

a. Gaskets: AWWA C111, rubber.

3. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American AVK Co.; Valves & Fittings Div.
b. American Cast Iron Pipe Co.; American Flow Control Div.
c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. East Jordan Iron Works, Inc.
f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
g. McWane, Inc.; Kennedy Valve Div.
h. McWane, Inc.; M & H Valve Company Div.
i. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
j. Mueller Co.; Water Products Div.
k. NIBCO INC.
l. U.S. Pipe and Foundry Company.
m. Or equal.

2. Nonrising-Stem, Resilient-Seated Gate Valves:

a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

3. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:

a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig (1380 kPa).
3) End Connections: Flanged.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
b. East Jordan Iron Works, Inc.
c. Flowserve.
d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
e. McWane, Inc.; Kennedy Valve Div.
f. McWane, Inc.; M & H Valve Company Div.
g. Mueller Co.; Water Products Div.
h. U.S. Pipe and Foundry Company.
i. Or equal.

2. Description: Sleeve and valve compatible with drilling machine.

a. Standard: MSS SP-60.

b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.6 CHECK VALVES

A. AWWA Check Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American AVK Co.; Valves & Fittings Div.
b. American Cast Iron Pipe Co.; American Flow Control Div.
c. APCO Williamette; Valve and Primer Corporation.
d. Crane Co.; Crane Valve Group; Crane Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
g. McWane, Inc.; Kennedy Valve Div.
h. McWane, Inc.; M & H Valve Company Div.
i. Mueller Co.; Water Products Div.
j. NIBCO INC.
k. Watts Water Technologies, Inc.
l. Or approved equal.

2. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.

a. Standard: AWWA C508.
b. Pressure Rating: 175 psig (1207 kPa).

2.7 WATER METERS

A. As required by the jurisdictional authority.

2.8 BACKFLOW PREVENTERS

A. Double-Check, Backflow-Prevention Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ames Fire & Waterworks; a division of Watts Regulator Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Flomatic Corporation.
e. Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Wilkins Water Control Products Div.

g. Or approved equal.

2. Standard: AWWA C510.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
7. Configuration: Designed for horizontal flow.
8. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.

2.9 CONCRETE VAULTS

A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.

1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.

   a. Dimension: 24-inch (610-mm) minimum diameter, unless otherwise indicated.

3. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.

   a. Dimension: 24-inch- (610-mm-) minimum diameter, unless otherwise indicated.

4. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.10 FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American AVK Co.; Valves & Fittings Div.
   b. American Cast Iron Pipe Co.; American Flow Control Div.
   c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
   d. American Foundry Group, Inc.
   e. East Jordan Iron Works, Inc.
   f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
   g. McWane, Inc.; Kennedy Valve Div.
   h. McWane, Inc.; M & H Valve Company Div.
   i. Mueller Co.; Water Products Div.
   j. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
   k. U.S. Pipe and Foundry Company.
   l. Or approved equal.

2. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure. Subject to jurisdictional authority's requirements.

   a. Standards: UL 246, FMG approved.

b. Pressure Rating: 250 psig (1725 kPa).
c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
d. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 3/4 to NPS 2 (DN 20 to DN 50) shall be the following:

1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A).

F. Underground water-service, fire-service, and combined water & fire-service piping NPS 2 1/2 (DN 65) and above shall be the following:

1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
2. PVC C-900, push-on-joint pipe; ductile iron, push-on joint fittings; and gasketed joints.

G. Water Meter Box Water-Service Piping NPS 3/4 to NPS 2 (DN 20 to DN 50) shall be same as underground water-service piping.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
2. Underground Valves, NPS 4 (DN 100) and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
3. Use the following for valves in vaults and aboveground:

a. Gate Valves, NPS 2 (DN 50) and Smaller: Bronze, nonrising stem.

b. Gate Valves, NPS 3 (DN 80) and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated.
c. Check Valves: AWWA C508, swing type.

3.4 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Make connections NPS 2 (DN 50) and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

E. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.

F. Bury piping with depth of cover over top at least 42 inches (1050 mm).

G. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

H. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.

3.6 ANCHORAGE INSTALLATION

A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.

B. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

E. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.8 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

3.9 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Support NPS 2-1/2 (DN 65) and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.10 WATER METER BOX INSTALLATION

A. Install water meter boxes in paved areas flush with surface.

B. Install water meter boxes in grass or earth areas with top 2 inches (50 mm) above surface.

3.11 CONCRETE VAULT INSTALLATION

A. Install precast concrete vaults according to ASTM C 891.

3.12 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. AWWA Fire Hydrants: Comply with AWWA M17.

3.13 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.14 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging, and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
3. Fill system or part of system with water/chlorine solution containing at least 60 ppm of chlorine; isolate and allow to stand for 24 hours.
    a. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 331116

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. These specifications are the minimum required. Public Sanitary Sewer Main and private service line shall be installed in accordance with jurisdictional authority requirements.

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Non-pressure and pressure couplings.
3. Expansion joints and deflection fittings.
4. Cleanouts.

1.3 SUBMITTALS

A. Product Certificates: For each type of cast-ron soil pipe and fitting, from manufacturer.

B. Field quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Profile Sewer Piping:

1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

B. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR 26, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
   Gaskets: ASTM F 477, elastomeric seals.

C. PVC Gravity Sewer Piping:

1. Pipe and Fittings: SDR 26, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

2.2 DEFLECTION FITTINGS

A. Ductile-Iron Deflection Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. EBAA Iron, Inc.
   b. Or approved equal.
2. Description: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include rating for 250-psig (1725-kPa) minimum working pressure and for up to 15 degrees of deflection.

2.3 CLEANOUTS

A. PVC Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Canplas LLC.
   b. IPS Corporation.
   c. NDS.
   d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.
   g. Or approved equal.
2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.4 CONCRETE

A. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

B. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section 312000 "Earthwork."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of micro tunneling.

F. Install gravity-flow, non-pressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent unless otherwise indicated.
2. Install piping with 72-inch (1830-mm) minimum cover under streets and pavement, and 48-inch (1220-mm) minimum cover in all other areas.
3. Install ductile-iron, gravity sewer piping according to ASTM A 746.
4. Install PVC profile sewer piping according to ASTM D 2321 and ASTM F 1668.
5. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
6. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.

G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, non-pressure, drainage piping according to the following:

1. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
2. Join PVC profile sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
3. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
4. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use non-pressure flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.

a. Unshielded flexible or rigid couplings for pipes of same or slightly different OD.
b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure pipe couplings for force-main joints.

3.4 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use PVC pipe fittings in sewer pipes at branches for cleanouts and use PVC pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 CONNECTIONS

A. Connect non-pressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 15 Section "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection

in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.

a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Connect to grease oil and sand interceptors as shown in the construction drawings.

3.7 IDENTIFICATION

A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.8 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

a. Fill sewer piping with water. Test with pressure of at least 10-foot (3-m) head of water and maintain such pressure without leakage for at least 15 minutes.

b. Close openings in system and fill with water.
c. Purge air and refill with water.
d. Disconnect water supply.
e. Test and inspect joints for leaks.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

3.9 CLEANING

A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 333113

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. Specifications listed herein are for private on-site storm drainage systems. Any off-site public storm drainage extensions shall follow the specifications of the local regulatory authority.

C. Regulatory authority's rules, regulations and specifications apply to this section.

1.2 SUMMARY

A. This Section includes storm drainage system piping and appurtenances from a point 5 feet outside the building to the point of disposal.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for drainage piping specialties.

C. Shop drawings for precast concrete sanitary manholes, including frames and covers.

D. Shop drawings for cast-in-place concrete or field-erected masonry storm drainage manholes and catch basins, including frames and covers.

1.4 QUALITY ASSURANCE

A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to storm drainage systems.

B. Utility Compliance: Comply with local utility regulations and standards pertaining to storm drainage systems.

1.5 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that storm drainage system piping may be installed in compliance with original design and referenced standards.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate connection to public sewer with utility company, if applicable.

B. Coordinate with interior building storm drainage piping, if applicable.

C. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to the following:

1. Underground Warning Tapes

a. Allen Systems, Inc; Reef Industries, Inc.
b. Brady (W.H.) Co.; Signmark Div.
c. Calpico, Inc.
d. Carlton Industries, Inc.
e. EMED Co., Inc.
f. Seton Name Plate Co.

2.2 PIPING AND FITTINGS

A. General: Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products is indicated on the plans, selection is installer's option.

B. Reinforced Concrete Sewer Pipe and Fittings: ASTM C 76, Class III, Wall B for rubber gasket joints.

1. PV Gasket: ASTM C 443, rubber.

C. PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: ASTM D 2665, Schedule 40 for solvent cement or elastomeric gasket joints.

1. Solvent Cement: ASTM D 2564.
2. Gaskets: ASTM F 477, elastomeric seal.

D. High Density Polyethylene Pipe (HDPE): AASHTO M252 Type S, M294 Type S, or ASTM F2306 smooth interior/annual exterior.

E. Couplings: Rubber or elastomeric sleeve and stainless-steel band assembly fabricated to match outside diameters of pipes to be joined.

1. Sleeves: ASTM F 443, rubber for concrete pipe; and ASTM F 477, elastomeric seal for plastic pipe. Sleeves for dissimilar or other pipe materials shall be compatible with pipe materials being joined.
2. Bands: Stainless steel, one at each pipe insert.

F. Couplings: Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub, and adjoining pipe outside diameter.

1. Gaskets: ASTM F 443, rubber for concrete pipe; and ASTM F 477, elastomeric seal for plastic pipe. Gaskets for dissimilar or other pipe materials shall be compatible with pipe materials being joined.

2.3 MANHOLES

A. As shown on the construction drawings.

2.4 CLEANOUTS

B. As shown on the construction drawings.

2.5 CATCH BASINS

A. As shown on the construction drawings.

2.6 CONCRETE AND REINFORCEMENT

A. Concrete: Portland cement mix, 4,000 psi.

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

A. Reinforcement: Steel conforming to the following:

1. Fabric: ASTM A185, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615, Grade 60, deformed.

2.7 IDENTIFICATION

A. Plastic Underground Warning Tapes: Polyethylene plastic tape, 6 inches wide by 4 mills thick, solid green in color with continuously printed caption in black letters "CAUTION – SEWER LINE BURIED BELOW."

PART 3 - EXECUTION

3.1 PREPARATION OF FOUNDATION FOR BURIED STORM DRAINAGE SYSTEMS

A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation, throughout the length of the pipe.

B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicate level.

C. Shape bottom of trench to fit bottom of pipe. Fill unevenness with tampered sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.

3.2 PIPE APPLICATION FOR UNDERGROUND STORM SEWERS

A. Install pipe size and type as indicated on the construction drawings.

3.3 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground storm drainage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical.

B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

C. Use manholes for changes in direction, except where a fitting is indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.

E. Install piping pitched down in direction of flow, at slopes indicated.

F. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking or a combination of both.

3.4 PIPE AND TUBE JOINT CONSTRUCTION AND INSTALLATION

A. Join concrete pipes and fittings with rubber gaskets in accordance with ASTM C 443 and install piping in accordance with applicable provisions of ACPA "Concrete Pipe Installation Manual."

B. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.

3.5 MANHOLES

A. General: Install manholes complete with accessories as indicated. Form continuous concrete or split pipe section channels and benches between inlet and outlet. Set tops of frames and covers flush with finish surface where manholes occur in pavements.

B. Place precast concrete manhole sections as indicated and install in accordance with ASTM C 891.

C. Construct cast-in-place manholes as indicated.

D. Provide rubber joint gasket complying with ASTM C 443 at joints of sections.

E. Apply bituminous mastic coating at joints of sections.

3.6 CLEANOUTS

A. Install cleanouts and extension from sewer pipe to clean out at grade as indicated. Set cleanout frame and cover with a 4" concrete collar, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grades or flush with grade when installed in paving.

3.7 CATCH BASINS

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.8 INSTALLATION OF IDENTIFICATION

A. Install continuous plastic underground warning tape during back-filling of trench for underground storm drainage service piping. Locate 6 to 8 inches below finished grade, directly over piping.

3.9 FIELD QUALITY CONTROL

A. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction.

B. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.

1. In large, accessible piping, brushes, and brooms may be used for cleaning.
2. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
3. Flush piping between manholes, if required by local authority, to remove collected debris.

C. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.

1. Make inspections after pipe between manholes and manhole locations has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
2. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects correct such defects and re-inspect.

END OF SECTION 334100

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States
BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

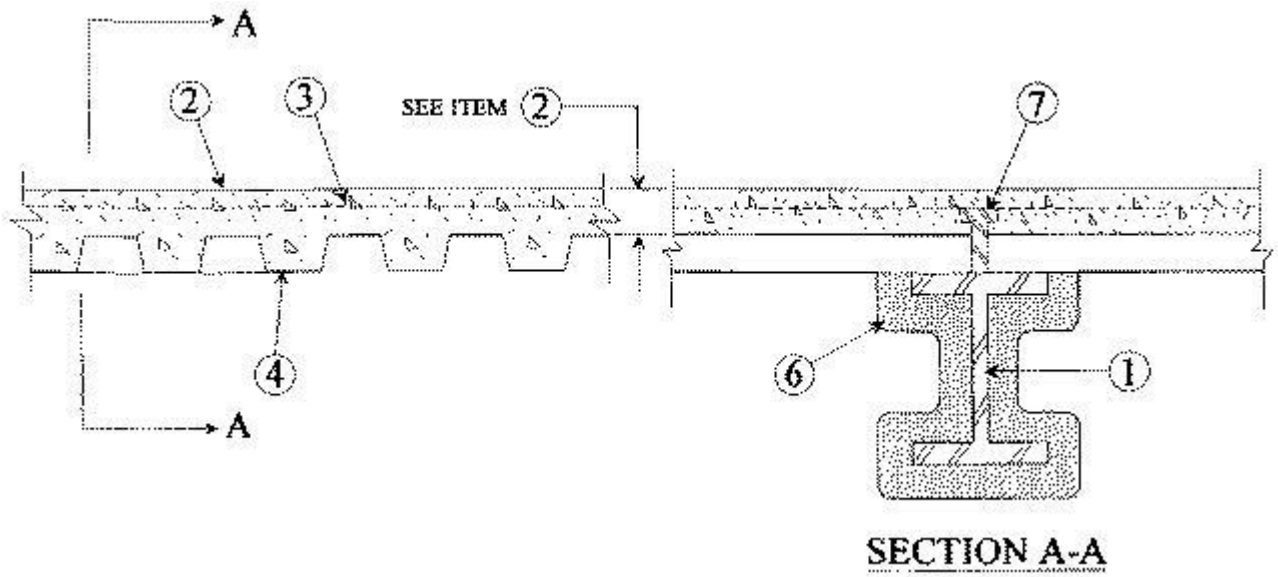
See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. D902

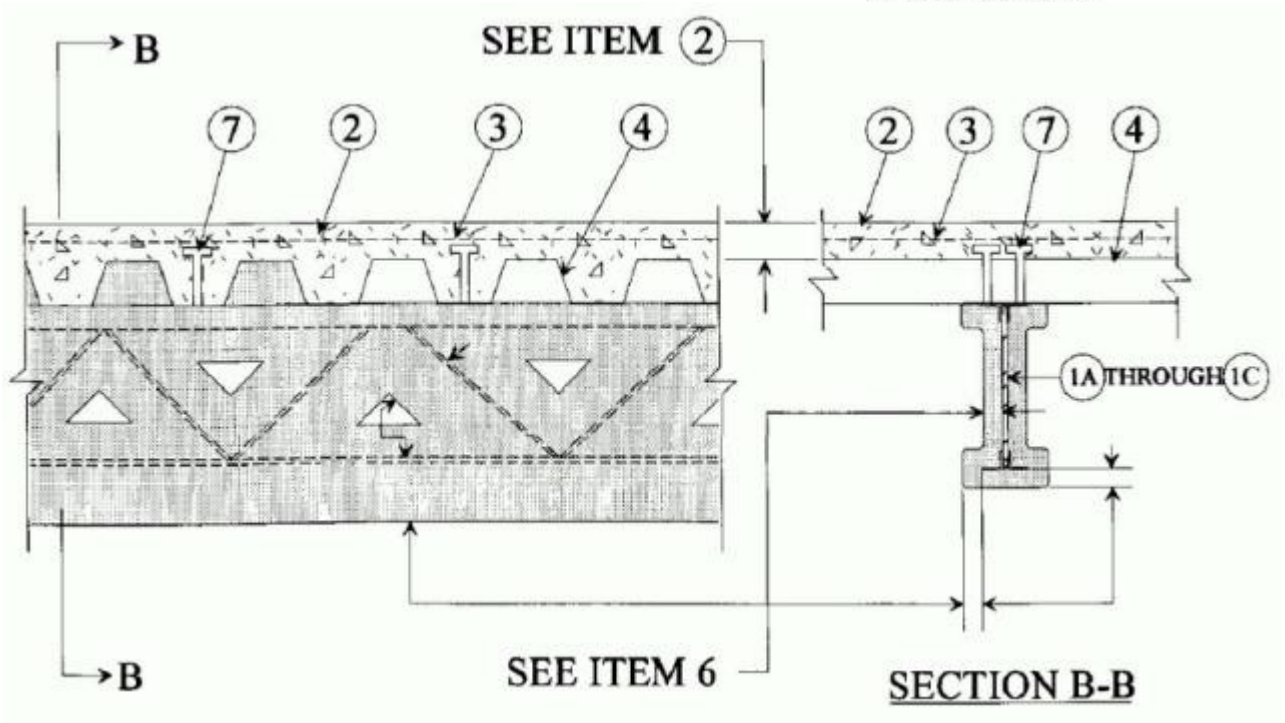
April 4, 2024

Restrained Assembly Ratings — 1, 1-1/2, 2 and 3 Hr.
Unrestrained Assembly Ratings — 0, 1, 1-1/2, 2 or 3 Hr. (See Items 4 & 6)
Unrestrained Beam Ratings — 1, 1-1/2, 2 and 3 Hr.
This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



SECTION A-A



SECTION B-B

1. **Beam —** W8X28, W8x24, W6x12 or W6x9, min size, see Items 6 through 6F.

1A. **Steel Joists —** (Not Shown) — As an alternate to Item 1 — Composite or non-composite min 8k1 or min depth and weight shall be 8 in. and 4.9 lb/ft respectively. May be uncoated or provided with a shop coat of paint. Designed per S.J.I. specifications for a max design stress of 30, 000 psi (30 ksi). Welded or bolted to end supports. The top chords shall consist of two angles measuring 1-1/4 by 1-1/4 by 0.127 in. thick. Bottom chords shall consist of two round bars measuring 0.566 in. in diam. or two angles measuring 1 by 1 by 0.125 in. thick. Bearing plates shall consist of two angles measuring 1-1/2 by 2 by 0.188 in. thick and 5-1/16 in. long. Web members shall consist of 0.565 in. diam bars.

1B. **Steel Joists —** (Not Shown) — As an alternate to Item 1 — Composite or non-composite min 12k5 or min depth and weight shall be 12 in. and 7.1 lb/ft respectively. May be uncoated or provided with a shop coat of paint. Designed per S.J.I. specifications for a max design stress of 30, 000 psi (30 ksi). Welded or bolted to end supports. Top chords shall consist of two angles measuring 1-1/2 by 1-1/2 by 0.156 in. thick. Bottom chords shall consist of two round bars measuring 0.675 in. in diam. or two angles measuring 1 by 1 by 0.125 in. thick. Bearing plates shall consist of two angles measuring 2 by 2 by 0.192 in. thick and shall be min 4-15/16 in long. The second web member at each end shall consist of 0.654 in. diam round bar. All remaining web members, including the end web members, shall consist of 0.774 in. diam round bars. Bridging per S.J.I. specifications is required when non-composite joists are used.

1C. **Steel Joists —** (Not Shown) — As an alternate to Item 1 — Composite or non-composite min 12k5 or min depth and weight shall be 12 in. and 7.1 lb/ft respectively. May be uncoated or provided with a shop coat of paint. Designed per S.J.I. specifications for a max design stress of 30, 000 psi (30 ksi). Welded or bolted to end supports. Top chords shall consist of two angles measuring 1-1/2 by 1-1/2 by 0.156 in. thick. Bottom chord shall consist of two round bars measuring 0.675 in. in diam. or two nangles measuring 1 by 1 by 0.125 in. thick. The second web member at each end shall consist of 0.654 in. diam round bar. All remaining web members, including the end web members, shall consist of 0.774 in. diam round bars. Bridging per S.J.I. specifications is required when non-composite joists are used.
Note: Additional beams or joists from the N series designs may be substituted for the listed beam (item 1) or joist (item 1A) respectively. When joists are substituted, the restrained rating of the joist must be equal to or greater than the restrained rating of the assembly. Additional beam and joist substitution requirements are in the front of the Fire Resistance Directory - III. FLOOR-CEILINGS AND ROOF-CEILING, item 7 -Steel Joist or IV. BEAMS.

2. **Normal Weight or Light Weight Concrete —** Normal weight concrete, carbonate or siliceous aggregate, 3500 psi compressive strength, vibrated. Light weight concrete, expanded shale or slate aggregate by rotary-kiln method or expanded clay aggregate by rotary-kiln or sintered-grate method, or pelletized expanded blast furnace slag aggregate, 3000 psi compressive strength, vibrated, 4 to 7 per cent entrained air.

Restrained Assembly Rating Hr	Concrete (Type)	Concrete Unit Weight pcf	Concrete Thkns In.
1	Normal Weight	147-153	3-1/2
1-1/2	Normal Weight	147-153	4
2	Normal Weight	147-153	4-1/2
3	Normal Weight	147-153	5-1/4
1	Light Weight	107-113	2-1/2
1	Light Weight	107-120	2-5/8
1-1/2	Light Weight	107-113	3
2	Light Weight	107-113	3-1/4
2	Light Weight	107-116	3-1/4*
2	Light Weight	114-120	3-1/2
3	Light Weight	107-113	4-3/16
3	Light Weight	114-120	4-7/16

* With 2 and 3 in. deep steel floor units only.

3. **Welded Wire Fabric —** 6x6 - W1.4xW1.4.

3A. **Negative Reinforcement —** (Optional, Not Shown) Used in lieu of Item 3 and with Items 3B or 3C. For floor spans with concrete cast continuous over the supporting beams. Deformed bars designed to resist the support moments of the concrete slab in accordance with the latest ACI Building Code Specifications.

3B. **Fiber Reinforcement* —** (Not Shown) — Required with Item 3A. Engineered synthetic fibers added to concrete mix to control shrinkage cracks in concrete. Fibers added to concrete mix at rate of 1 lb of fiber for each cubic yard of concrete.
PROPEX OPERATING COMPANY L L C — Fibermesh 150 and Fibermesh 300.

3C. **Fiber Reinforcement* —** (Not Shown) — Required with Item 3A. Any fiber reinforcement bearing the UL Classification Marking for Fire Resistance, Classified for use in lieu of welded wire fabric.
See **Fiber Reinforcement** (CBXQ) Category for names of manufacturers.

4. **Steel Floor and Form Units* —** Composite or non-composite, 1-1/2, 1-5/8 , 2 or 3 in. deep galv units or 4-1/2 in. deep non-composite galv units. Fluted units may be phos/ptd. Min gauges are 22 MSG for fluted and 20/20 for cellular and partial cellular units. The following combinations of units may be used:
(1) All 24, 26, 28 or 36 in. wide cellular or partial cellular.

(2) All fluted.

(3) One or two 3 in. deep, 12 in. wide, 18/18 MSG min cellular alternating with 3 in. deep fluted or other cellular.

(4) Any blend of fluted and 24, 26, 28 or 36 in. wide cellular or partial cellular.

(5) Corrugated, nom 1-5/16 or 2 in. deep, 30 in. wide, 24 MSG min galv units with shear wires factory welded to deck corrugations. Welded to supports 12 in. OC through welding washers. For shear wire spacing of 8 in. or less the steel deck stress shall not exceed 20 KSI. For shear wire spacing greater than 8 in. OC but less than or equal to 12 in. OC steel deck stress shall not exceed 12 KSI.

AGWAY METALS INC — 24 to 36 in. wide Types CD36 , CD36 Inverted , CD75-150, CD75-150 Inverted, CD75-200 Inverted, CD75-300 , RD75-300.

ASC STEEL DECK, DIV OF ASC PROFILES L L C — 32 in. wide Types NH-32, NHN-32, NHF-32; 36 in. wide, Types BH-36, BHN-36, BHN-35-1/4, BHF-36, BHF-36A, 2WH-36, 2WHS-36, 2WHF-36, 2WHF-36A, 3WxH-36, 3WxHF-36, 3WxHF-36A, 3WH-36, 3WHF-36, 3WHF-36A, 3W-36, 3WF-36, DG3W-36, DG3WF-36. All units may be galvanized or Prime Shield. Non-cellular decks may be vented designated with a "V" suffix to the product name. Cellular deck top and bottom sections may be riveted together (designated with "Fr") vs. arc spot welded, "F"

CANAM GROUP INC — 24 in. wide Type P-2432 composite or 36 in. wide Type P-3623, P-3606, P-3615 and 24 in wide Type P-2432 composite, Type P-3606 and P-3615 non-composite; 24 or 36 in. wide Type 3 in. LOK-Floor; 36 in. wide Types 1.5B, 1.5BI, 1.5BL and 1.5BL.

CANAM STEEL CORP — 12 or 24 in. wide, Types 1-1/2, 2, or 3 in. LOK-Floor and LOK-Floor Cell; 36 in. wide, Types 2 or 3 in. LOK-Floor and LOK-Floor Cell; 24, 30 or 36 in. wide, Type 1-1/2 in. B-LOK and B-LOK Cell; 24 in. wide, Types N-LOK and N-LOK Cell

CENTRIA, A DIVISION OF NCI GROUP, INC — QL Types, 24 in. wide, 3 or 3 inverted, UKX, 21 or 21 inverted, 2 in. 99, 121, AKX, NKX, TKX; 24 or 30 in. wide GKX, GKXH, GKX-A; 36 in. wide 2 in. 99, AKX, WKX; 12 in. wide NKC, TKC; 12 in. wide non-composite Sec 12. Side joints of 99, 121, TKC, TKX, WKX may be welded together 60 in. OC. Side joints of 99, AKX, WKX, GKX, GKX-A, TKX may be fastened together with min 1 in. long No. 12x14 self-drilling, self-tapping steel screws 36 in. OC

CHIA TEH CONSTRUCTION MATERIAL CO LTD — 24 or 36 in. wide Mac-Lok 3; 24 in. wide CFD-3

CSM PRODUCTS & SOLUTIONS, LLC — Types 1-1/2”, 2” and 3” deep composite decks.

DECK WEST INC — 36 in. wide Type B-DW, Inverted B-DW, BA-DW, Inverted BA-DW, 2-DW or 3-DW. Side joints of Type 2-DW and 3-DW may be fastened together with min 1 in. long No. 12 x 14 self-drilling, self-tapping steel screws 36 in. OC

DECKCO LLC – 36 in. wide, Types DC 1.5B, DC 1.5 Form, DC 1.5 Inverted Composite, DC 1.5 Inverted Form, DC 1.5 Composite, DC 2 Form, DC 2 Composite, DC 3 Form, DC 3 Composite.

DESIGN ASSISTANCE CONSTRUCTION SYSTEMS INC — 36 in. wide Type DACS1.5CD, or 24 in. wide Type DACS2.0CD, or DACS3.0CD

EPIC METALS CORP — 24 in. wide Types EC150, EC150 inverted, EC300, EC366, ECP150, ECP300, ECP366, ECA; 30 in. wide Types ECB150, ECBR150; 36 in. wide Types EC156, EC266, ECP266

INTSEL STEEL EAST LLC — 36 in. wide Types 1.5" COMPOSITE/FLOOR, 2" COMPOSITE/FLOOR, 3" COMPOSITE/FLOOR.

KAM INDUSTRIES LTD, DBA CORDECK — 24 in. wide, Types 2 or 3 in. WDR

MARLYN STEEL DECKS INC — Type 1.5 CF, 2.0 CF or 3.0 CF

NEW MILLENNIUM BUILDING SYSTEMS L L C — 24 or 36 in. wide Types 2.0CD, 3.0CD, 2.0CFD, 3.0CFD, 3.0CFDES; 24, 30 or 36 in. wide Types 1.5CD, 1.5CDI, 1.5CDR, 1.5CFD. Fluted units may be phos/painted or galvanized.

ROOF DECK INC — 36 in. wide Types LOK-1-1/2, LOK-1-1/2R; 24 in. wide Types LOK-2, LOK-3

STEEL MASTERS INTERNATIONAL DEPENDABLE STEEL — 36 in. wide Types 2WH-36, 3WH-36. Units may be phos/painted or galvanized.

VALLEY JOIST+DECK — 24 or 36 in. wide Types WVC 1-1/2 or WVC 2

VERCO DECKING INC - A NUCOR CO — FORMLOK™ deck types PLB, B, BR, PLN3, N3, PLN, N, PLW2, W2, PLW3, W3. Units are min 24 in. wide and may be galvanized, phos./ptd., or mill finish. Units may be cellular or acoustical cellular, with the suffix "CD" or "CD-AC" added to the product name, respectively. All non-cellular deck may be vented or non-vented. 12 in. wide PLW2, W2, PLW3 or W3 units may be blended with 24 or 36 in. wide PLW2, W2, PLW3 or W3 units, respectively; or Types PLN3-CD, N3-CD, PLN3, N3.

VULCRAFT, DIV OF NUCOR CORP — 24, 30 or 36 in. wide Types 1.5VL, 1.5VLI, 1.5PLVLI, 1.5VLP, 1.5 VLR, 1.5PLVLP; 24 or 36 in. wide Types 1.5VLPA, 1.5PLVLPA, 2VLI, 2.0PLVLI, 2VLJ, 3VLI, 3.0PLVLI, 3VLJ, 2VLP, 2.0PLVLP, 3VLP, 3.0PLVLP, 2VLPA, 2.0PLVLPA, 3VLPA, 3.0PLVLPA. Types 1.5VL, 1.5VLI, 1.5PLVLI, 1.5 VLR, 1.5VLPA, 1.5PLVLPA, 2VLI, 2.0PLVLI, 2VLJ, 3VLI, 3.0PLVLI, 3VLJ units may be phos/ptd. 24 or 36 in. wide Types 2VLJ, 3VLJ units ++ may be used for max 2 hr Restrained Assembly Rating. 36 in. wide Types 1.5 SB, 1.5 SBR; 24 or 36 in wide Types 2.0 SB, 3.0 SB, 36 in. wide Type High Strength 1.5 SBI, 36 in. wide Type High Strength 1.5 SBN; Units may be phos/ptd

Spacing of welds attaching units to supports shall be 12 in. OC for 12, 24, 36 in. wide units, four welds per sheet for 30 in. wide units. 6 in. OC for 18 in. wide and Sec. 12 units. Unless specified otherwise for specific units types, adjacent units button-punched or welded together 36 in. OC along side joints. For **3 Hr Rating**, units with overlapping type side joints welded together 24 in. OC max.

When a superimposed load of 250 PSF is desired the spacing of welds or button-punches shall not exceed 24 in. OC along side joints.

++ Side joints of Types 2VLJ or 3VLJ units may be fastened together with No. 8-3/4 in. long self-drilling Tek screws driven diagonally from the top side through the joint of the units at 36 in. O. C. max.

Alternate Construction — Non-composite units of the same type listed above may be used provided allowable loading is calculated on the basis of non-composite design.

The Unrestrained Assembly Rating is equal to the Unrestrained Beam Rating (See Item 6) for a max 3 Hr and is limited to the following units and limitations:

(a) 1-1/2, 2 and 3 in. deep, 24 or 36 in. wide, 22 MSG or thicker fluted with clear spans not more than 7 ft, 8 in.

(b) 1-1/2, 2 and 3 in. deep, 24 or 36 in. wide, 20 MSG or thicker fluted with clear spans not more than 8 ft, 8 in.

(c) 1-1/2 and 2 in. deep, 24 or 36 in. wide, 16 MSG or thicker fluted and 18/18 MSG or thicker cellular with clear spans not more than 9 ft, 11 in.

(d) 3 in. deep, 36 in. wide, 18 MSG or thicker fluted and 24 in. wide, 20/18 MSG or thicker cellular with clear spans not more than 13 ft, 2 in.

For assemblies utilizing 3-1/4 in. light weight concrete topping with a max Restrained Assembly Rating of 2 Hr, the Unrestrained Assembly Rating is equal to the Unrestrained Beam Rating (See Item 6) and is limited to the following floor units and spans:

(a) 1-1/2, 2 and 3 in. deep, 24 or 36 in. wide, 22 MSG fluted and 20/20 MSG cellular with clear spans not more than 9 ft, 6 in.

(b) 2 and 3 in. deep, 24 or 36 in. wide, 20 MSG fluted and 20/20 MSG cellular with clear spans not more than 10 ft, 0 in.

(c) 3 in. deep, 24 in. wide, 20 MSG fluted and 20/20 MSG cellular with clear spans not more than 13 ft, 2 in.

4A. **Steel Floor and Form Units* —** As an alternate to Item 4. Nom 8 or 9 in. deep composite, galv steel units. Min thickness 0.0375 inch (20 MSG). Side joints of adjacent units fully overlapping, fastened together by using 1-1/4 in. long self-drilling, self-tapping steel screws driven through Shear-Bond Clips (not shown) at 13-3/4 in. OC. Steel end closures flashings (not shown) made of min 0.056 inch thick (16 MSG) galv steel, fixed to the steel work before decking is placed.

In addition to the Steel Floor and Form Units, the following components are required:

(a) Welded Wire Fabric — 6 X 6 - Min wire thickness W2.9 X W2.9 slab reinforcement. As an alternate, max # 4 bars spaced 12-in. OC in both directions shall be used. When re-bars are used, the concrete slab thickness shall be increased a minimum 5/16 in.

(b) Rib Reinforcement —Min. #4 rebar. Min concrete cover below the steel reinforcement shall be 1-9/16 in. Reinforcement support chairs spaced at max 41-1/2 inches OC.

The flute areas above the beam/joist are to be : (1) filled with concrete, (2) filled with Spray-Applied Fire Resistive Material or (3) the beam/joist coated with Spray-Applied Fire Resistive Material installed as described in the design to thickness required when all cellular Steel Floor and Form Units are used.

See Design No. D989 for a typical illustration of the components. Consult the deck manufacturer for comprehensive load tables and design parameters referencing UL Design D989.

BAILEY METAL PRODUCTS LTD — Type COMSLAB™ 120, COMSLAB™ 210 and COMSLAB™ 225, Steel End Closure Flashing

5. **Joint Cover —** (Use with fluted units optional — Not Shown) — 2 in. wide cloth adhesive tape applied following the contour of the units.

6. **Spray-Applied Fire Resistive Materials* —** Applied by spraying with water to the final thicknesses shown below. When fluted steel deck is used and the fire protection thickness selected is based on all fluted deck, the area between the steel deck and the top flange of the steel beam shall be filled. When fluted steel deck is used and the steel beam is sprayed with the thicknesses applicable to cellular of blended units, the area between the steel deck and the top flange of the steel beam shall be plugged. Beam surfaces must be clean and free of dirt, loose scale, and oil. Min average density of 13 pcf with min. individual density of 11 pcf for Types II, II HS, or DC/F. Min average and min individual densities of 22 pcf and 19 pcf, respectively, for type HP. For method of density determination, refer to Design Information Section. The thickness of the Spray-Applied Fire Resistive Materials on the Structural Members (Item 1, 1A, or 1B) shall be as follows:

			Min Thkns Spray Applied Resistive Mtl, In					
Restrained Assembly Rating Hr	**Unrestrained Beam Rating Hr**	**Concrete Type**	**W6x9 When Deck Is All Fluted**	**W6x9 When Deck Is Blend or All Cellular**	**W8x28 When Deck Is All Fluted**	**W8x28 When Deck Is Blend or All Cellular**	**Joist Item 1A When Deck Is Fluted Cellular or Blend**	**Joist Item 1B When Deck Is Fluted Cellular or Blend**
1	1	NW	9/16,15/16*	9/16, 1*	3/8,5/8*	3/8,11/16*	1+	—
1-1/2	1	NW	9/16,15/16*	9/16, 1*	3/8,5/8*	3/8,11/16*	1-9/16	—
2	1	NW	9/16,15/16*	9/16, 1*	3/8,5/8*	3/8,11/16*	2-1/16	—
2	2	NW	1-1/8	1-3/16	3/4	13/16	2-1/16	—
2	3	NW	1-3/4	1-7/8	1-3/16	1-5/16	—	3-1/4
3	1-1/2	NW	3/4	3/4	1/2	1/2	—	3-1/4

3	2	NW	1-1/8	1-3/16	3/4	13/16	—	3-1/4
3	3	NW	1-3/4	1-7/8	1-3/16	1-5/16	—	3-1/4
1	1	LW	9/16,15/16*	5/8, 1*	3/8,5/8*	7/16,11/16*	1-1/8+	—
1-1/2	1	LW	9/16,15/16*	5/8, 1*	3/8,5/8*	7/16,11/16*	1-3/4	—
2	1	LW	9/16,15/16*	5/8, 1*	3/8,5/8*	7/16,11/16*	2-1/4	—
2	2	LW	1-7/16	1-7/16	1	1	2-1/4	—
2	3	LW	2-1/4	2-5/16	1-9/16	1-5/8	—	3-1/4
3	1-1/2	LW	15/16	1	5/8	11/16	—	3-1/4
3	2	LW	1-7/16	1-7/16	1	1	—	3-1/4
3	3	LW	2-1/4	2-5/16	1-9/16	1-5/8	—	3-1/4

* This thickness applies when optional Item 12 or 13 are used over 3-1/4 in. light weight concrete topping.

** This thickness applies when optional Item 12 or 13 are used over 3-1/4 in. light weight concrete topping.

+ When bottom chords consist of 1 by 1 by 0.125 in. thick steel angles, the thickness of spray-applied fire resistive material shall be increased by 1/4 in. on the bottom chord only.

ISOLATEK INTERNATIONAL — Type D-C/F, HP, II or Type II HS. Investigated for exterior use. Type EBS or Type X adhesive/surface sealer optional.

6A. **Spray-Applied Fire Resistive Materials* —** Alternate to Item 6. See table below for appropriate thicknesses. When fluted steel deck is used and the fire protection thickness selected is based on all fluted deck, the area between the steel deck and the top flange of the steel beam shall be filled. When fluted steel deck is used and the steel beam is sprayed with the thicknesses applicable to cellular or blended units, the area between the steel deck and the top flange of the steel beam shall be plugged. Prepared by mixing with water and spray-applied in one or more coats to beam surfaces which must be clean and free of dirt, loose scale and oil. Min average density of 17.5 pcf with min individual value of 17.0 pcf. For method of density determination, see Design Information Section, Sprayed Material.

Restrained Assembly Rating Hr	Unrestrained Beam Rating Hr	Min Thkns Applied Resistive Mtl, In			
		W6x9 When Deck Is All Fluted	W6x9 When Deck Is Blend or All Cellular	W8x28 When Deck Is All Fluted	W8x28 When Deck Is Blend or All Cellular
1, 1-1/2, 2	1	1/2, 5/8*	1/2, 5/8*	5/16, 7/16*	5/16, 7/16*
2	2	1	1-3/16	11/16	13/16
2	3	1-9/16	1-7/8	1-1/16	1-5/16
3	1-1/2	3/4	13/16	1/2	9/16
3	2	1	1-3/16	11/16	13/16
3	3	1-9/16	1-7/8	1-1/16	1-5/16

* This thickness applies when optional Items 12, 13 are used over 3-1/4 in. light weight concrete topping.

ISOLATEK INTERNATIONAL — Type 280

6B. **Spray-Applied Fire Resistive Materials* —** Alternate to Items 6 and 6A. Prepared by mixing with water. Spray-applied in one or more coats to beam surfaces to a min final thickness as shown in the tables below. Beam surfaces must be clean and free of dirt, loose

scale and oil. When fluted steel deck is used and the fire protection thickness selected is based on all fluted deck, the area between the steel deck and the top flange of the steel beam shall be filled. When fluted steel deck is used and the steel beam is sprayed with the thicknesses applicable to cellular or blended units, the area between the steel deck and the top flange of the steel beam shall be plugged.

Min average and min individual density of 15 pcf and 14 pcf respectively for Types 300, 300AC, 300 ES, 300 HS, 300 N, 3000, 3000ES, and SB. For Types 400, 400 AC and 400 ES min average and min individual density of 22 pcf and 19 pcf respectively. Min avg density of 44 pcf with min ind value of 40 pcf for Types M-II and TG. Min avg density of 47 pcf, with min individual value of 43 pcf for Type M-II/P. The thickness of the material on the Structural Members (Item 1 and 1C) shall be as follows:

		Min Thkns Spray Applied Resistive Mtl, In				
Restrained Assembly Rating Hr	**Unrestrained Beam Rating Hr**	**W6x9 When Deck Is All Fluted**	**W6x9 When Deck Is Blend or All Cellular**	**W8x28 When Deck Is All Fluted**	**W8x28 When Deck Is Blend or All Cellular**	**Joist (Item 1C) When Deck Is Fluted Cellular or Blend**
1	1	1/2 , 5/8*	1/2 , 5/8*	5/16, 7/16*	5/16, 7/16*	9/16+
1-1/2	1	1/2 , 5/8*	1/2 , 5/8*	5/16, 7/16*	5/16, 7/16*	1
2	1	1/2 , 5/8*	1/2 , 5/8*	5/16, 7/16*	5/16, 7/16*	1-3/8
2	2	1	1-3/16	11/16	13/16	1-3/8
2	3	1-9/16	1-7/8	1-1/16	1-5/16	2-1/4
3	1-1/2	3/4	13/16	1/2	9/16	2-1/4
3	2	1	1-3/16	11/16	13/16	2-1/4
3	3	1-9/16	1-7/8	1-1/16	1-5/16	2-1/4

* This thickness applies when optional Item 12 or 13 are used over 3-1/4 in. light weight concrete topping.

+ When bottom chords consist of 1 in. by 1 in. by 0.125 in. thick steel angles, the thickness of spray-applied fire resistive material shall be increased by 1/4 in. on the bottom chord only.

BERLIN CO LTD — Types 300, 300ES, 300N, SB, or 400; Type M-II, TG and M-II/P

GREENTECH ASIA PACIFIC SDN BDH — Types 300, 300ES, 300HS, or 400; Type M-II, or M-II/P

ISOLATEK INTERNATIONAL — Types 300, 300AC 300ES, 300HS, 300N, SB, 400, 400AC, 400ES, 3000 or 3000ES; Type M-II, TG and M-II/P

NEWKEM PRODUCTS CORP — Types 300, 300ES, 300N, 400, or SB; Type M-II, TG and M-II/P

6C. **Intumescent Fire-resistive Materials * —** As an alternate to Items 6 through 6B. For use with fluted steel floor and form units only. Min. size W8x24 or W6x12 beams shall be primed with a phenolic modified alkyd primer, a metal alkyd primer, an acrylic primer or an epoxy primer at a nominal thickness of 2 mil. Coating spray or brush applied in accordance with the manufacturer's instructions at the min dry thickness as shown in the table below. The thickness shown below includes the primer thickness. Flutes above beam to be completely filled with minimum 6 pcf mineral wool insulation, or the top flange of the beam to be protected with the same thickness of coating as required on the beam.

Minimum Dry Thickness mils	**Minimum Dry Thickness mm**	**Beam Size**	**Unrestrained Beam Rating Hr**	**Restrained Assembly Rating Hr**
53	1.34	W8x24	1	2

95	2.41	W8x24	1-1/2	3
73	1.83	W6x12	1	2
123	3.10	W6x12	1-1/2	3

ALBI MFG, DIV OF STANCHEM INC — Type Albi Clad TF+. Investigated for Interior General Purpose.

BERLIN CO LTD — Type WB 3. Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB4, Investigated for Exterior Use with top coat as described in Item 6E

ISOLATEK INTERNATIONAL — Type SprayFilm-WB 3 and Type WB 3. Investigated for Interior General Purpose. Type SprayFilm-WB 4 and Type WB 4, Investigated for Interior General Purpose. Type SprayFilm-WB 4 and Type WB4, Investigated for Exterior Use with top coat as described in Item 6E

ISOLATEK INTERNATIONAL — Type Albi Clad TF+. Investigated for Interior General Purpose.

NEWKEM PRODUCTS CORP — Type WB 3. Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB4, Investigated for Exterior Use with top coat as described in Item 6E

6D. **Intumescent Fire-resistive Materials * —** As an alternate to Items 6 through 6C. For use with normal weight concrete. Min. size W8x28 beams shall be primed with a phenolic modified alkyd primer a metal alkyd primer, an acrylic primer or an epoxy primer at a nominal thickness of 2 mil. Coating spray or brush applied in accordance with the manufacturer's instructions at the min dry thickness as shown in the table below. The thickness shown below includes the primer thickness. The top surface of the top flange where fluted units are used must be protected with the coating material at the same min dry thickness at a min distance of 1 in. (25 mm) inward from the flange tip on both sides of the beam. Mineral wool insulation optional above top surface of the beam.

Minimum Dry Thickness mils	Minimum Dry Thickness mm	Steel Floor Units	Unrestrained Beam Rating Hr	Restrained Assembly Rating Hr
103	2.62	Fluted or Cellular	1-1/2	2
179	4.55	Cellular	1-1/2	3
341	8.67	Cellular	2	3

ALBI MFG, DIV OF STANCHEM INC — Type Albi Clad TF+. Investigated for Interior General Purpose.

BERLIN CO LTD — Type WB 3. Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB 4, Investigated for Exterior Use with top coat as described in Item 6E

ISOLATEK INTERNATIONAL — Type SprayFilm-WB 3 and Type WB 3. Investigated for Interior General Purpose. Type SprayFilm-WB 4 and Type WB 4, Investigated for Interior General Purpose. Type SprayFilm-WB 4 and Type WB 4, Investigated for Exterior Use with top coat as described in Item 6E

ISOLATEK INTERNATIONAL — Type Albi Clad TF+. Investigated for Interior General Purpose.

NEWKEM PRODUCTS CORP — Type WB 3. Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB4, Investigated for Exterior Use with top coat as described in Item 6E

6E. **Top Coat —** Type SprayFilm — TOPSEAL and Type TOPSEAL required for Exterior Use, applied at a minimum dry thickness of 14 mils (0.34 mm) over the intumescent material.
See Classification information in the **Mastic and Intumescent Coating** (CDWZ) category, Isolatek International, for mixing requirements.

6F. **Intumescent Fire-resistive Materials * —** As an alternate to Items 6 through 6D. For use with normal weight or light weight concrete and fluted steel floor and form units only. Min size W8x24 beams shall be primed with a phenolic modified alkyd primer at a thickness of 2 mils or a epoxy primer at a nominal thickness of 1 mil. Coating spray or brush applied in accordance with the manufacturer's instructions at the thicknesses shown below. The thickness includes the thickness of primer. The top surface of the top flange where fluted units are used must be protected with the coating material at the same min dry thickness or filled with nominal 4 pcf mineral wool.

Minimum Dry Thickness mils	Minimum Dry Thickness mm	Beam Size	Unrestrained Beam Rating Hr	Restrained Assembly Rating Hr
35	0.88	W8x24	1	2
66	1.68	W8x24	1-1/2	3

ISOLATEK INTERNATIONAL — Type WB-5. Investigated for Interior General Purpose, Investigated for Exterior Use with top coat as described in Item 6G.

NEWKEM PRODUCTS CORP — Type WB 5, Investigated for Interior Conditioned Space and Interior General Purpose, Investigated for Exterior Use with top coat as described in Item 6G.

6G. **Top Coat —** (Not Shown) — Type TNEMEC 740 required for Exterior Use with Type SprayFilm WB5, applied at a minimum dry thickness of 7 mils over the intumescent material.

See Classification information in the **Mastic and Intumescent Coating** (CDWZ) category, Isolatek International, for mixing requirements.

6H. **Sprayed Fiber Insulation* —** (Optional, Not Shown) — Spray applied fiber insulation, Classified to Surface Burning Characteristics (BNST), having a maximum applied density of 3.5 pcf, applied over Spray-Applied Fire Resistive Material (Item 6) on both steel floor and form units (Item 4) and supports (Item 1). Sprayed fiber insulation may be over Spray-Applied Fire Resistive Material (Item 6) according to the following tables:

Allowable Spray-Applied Fiber Insulation Thickness Over Beam

Installed SFRM Thickness (in.) on Beam	SFRM Density (pcf)						
	13	15	17.5	22	22 (Type HP)	44	47
3/8	6-3/4	4	4-11/16	5-7/8	8	8	8
7/16	6-1/2	3-3/4	4-3/8	5-1/2	8	8	8
1/2	6-1/4	3-1/2	4-1/16	5-1/8	8	8	8
9/16	6-1/16	3-3/16	3-3/4	4-11/16	8	8	8
5/8	5-13/16	2-15/16	3-7/16	4-5/16	8	8	8

11/16	5-9/16	2-11/16	3-1/8	3-15/16	8	8	8
3/4	5-5/16	2-7/16	2-13/16	3-9/16	8	8	8
13/16	5-1/8	2-1/8	2-1/2	3-1/8	8	8	8
1	4-7/16	1-5/16	1-9/16	1-15/16	7-7/16	6-5/16	6-11/16
1-1/16	4-3/16	1-1/16	1-1/4	1-9/16	7-1/16	5-1/2	5-7/8
1-3/16	3-11/16	9/16	5/8	13/16	6-5/16	3-15/16	4-3/16
1-5/16	3-1/4	0	0	0	5-1/2	2-3/8	2-1/2
1-9/16	2-5/16	0	0	0	3-15/16	0	0
1-5/8	2-1/16	0	0	0	3-9/16	0	0

Allowable Spray-Applied Fiber Insulation Thickness Over Joist

Installed SFRM Thickness (in.) on Joist **SFRM Density (pcf)**

	13	15	22	22 (Type HP)	44	47
9/16	8	8	8	8	8	8
13/16	8	8	8	8	8	8
1	8	8	8	8	8	8
1-1/8	7-7/8	7-1/2	8	8	8	8
1-1/4	7-7/16	6-15/16	8	8	8	8
1-3/8	6-15/16	6-7/16	8	8	8	8
1-9/16	6-1/4	5-5/8	8	8	8	8
1-3/4	5-9/16	4-13/16	7-1/16	8	8	8
2-1/16	4-7/16	3-1/2	5-1/8	7-7/16	8	8
2-1/4	3-11/16	2-11/16	3-15/16	6-5/16	7-7/8	8
3-1/4	0	0	0	0	0	0

INTERNATIONAL CELLULOSE CORP — Type K13, URE-K, or Sonospray FC

6I. **Sprayed Fiber Insulation* —** (Optional, Not Shown) — Spray applied fiber insulation, Classified for Noncombustible Building Materials (BICW), having a maximum applied density of 3.5 pcf, applied over Spray-Applied Fire Resistive Material (Item 6) on both steel floor and form units (Item 4) and supports (Item 1). Sprayed fiber insulation may be over Spray-Applied Fire Resistive Material (Item 6) according to the following tables:

Allowable Spray-Applied Fiber Insulation Thickness Over Beam

Installed SFRM Thickness (in.) on Beam	SFRM Density (pcf)						
	13	15	17.5	22	22 (Type HP)	44	47
5/16	5	5	5	5	5	5	5
3/8	5	5	5	5	5	5	5
7/16	5	5	5	5	5	5	5
1/2	5	5	5	5	5	5	5
9/16	5	5	5	5	5	5	5
5/8	5	5	5	5	5	5	5
11/16	5	5	5	5	5	5	5
3/4	5	4-13/16	5	5	5	5	5
13/16	5	4-9/16	5	5	5	5	5
15/16	5	4	4-11/16	5	5	5	5
1	4-7/8	3-3/4	4-3/8	5	5	5	5
1-1/16	4-5/8	3-1/2	4-1/16	5	5	5	5
1-1/8	4-7/16	3-3/16	3-3/4	4-11/16	5	5	5
1-3/16	4-3/16	2-15/16	3-7/16	4-5/16	5	5	5
1-5/16	3-11/16	2-7/16	2-13/16	3-9/16	5	5	5
1-7/16	3-1/4	1-7/8	2-3/16	2-3/4	5	5	5
1-9/16	2-13/16	1-5/16	1-9/16	1-15/16	4-11/16	3-15/16	4-3/16
1-5/8	2-9/16	1-1/16	0	1-9/16	4-5/16	3-1/8	3-3/8
1-3/4	2-1/16	9/16	0	13/16	3 9/16	1-9/16	1-11/16
1-7/8	1-5/8	0	0	0	2 3/4	0	0
2-1/4	1/4	0	0	0	3/8	0	0
2-5/16	0	0	0	0	0	0	0

Allowable Spray-Applied Fiber Insulation Thickness Over Joist

Installed SFRM Thickness (in.) on Joist	SFRM Density (pcf)					
	13	15	22	22 (Type HP)	44	47
9/16	5	5	5	5	5	5
13/16	5	5	5	5	5	5
1	5	5	5	5	5	5
1-1/8	5	4-13/16	5	5	5	5
1-1/4	5	4-5/16	5	5	5	5
1-3/8	5	3-3/4	5	5	5	5
1-9/16	5	2-15/16	4-5/16	5	5	5
1-3/4	5	2-1/8	3-1/8	5	5	5
2-1/16	5	13/16	1-3/16	5	5	5
2-1/4	5	0	0	5	5	5
3-1/4	0	0	0	0	0	0

THERMACOUSTICS IND — Type TC-417

6J. **Sprayed Fiber Insulation* —** (Optional, Not Shown) — Spray applied fiber insulation, Classified to Surface Burning Characteristics (BNST), having a maximum applied density of 2.8 pcf, applied over Spray-Applied Fire Resistive Material (Item 6) on both steel floor and form units (Item 4) and supports (Item 1). Sprayed fiber insulation may be over Spray-Applied Fire Resistive Material (Item 6) according to the following tables:

Allowable Spray-Applied Fiber Insulation Thickness Over Beam

Installed SFRM Thickness (in.) on Beam	SFRM Density (pcf)						
	13	15	17.5	22	22 (Type HP)	44	47
5/16	5	5	5	5	5	5	5
3/8	5	5	5	5	5	5	5
7/16	5	5	5	5	5	5	5
1/2	5	5	5	5	5	5	5
9/16	5	5	5	5	5	5	5
5/8	5	5	5	5	5	5	5
11/16	5	5	5	5	5	5	5
3/4	5	5	5	5	5	5	5
13/16	5	5	5	5	5	5	5
15/16	5	5	5	5	5	5	5

1	5	4-11/16	5	5	5	5	5
1-1/16	5	4-3/8	5	5	5	5	5
1-1/8	5	4	4-11/16	5	5	5	5
1-3/16	5	3 11/16	4- 5/16	5	5	5	5
1-5/16	4-5/8	3	3-1/2	4-7/16	5	5	5
1-7/16	4-1/16	2-3/8	2-3/4	3-7/16	5	5	5
1-9/16	3-1/2	1-11/16	1-15/16	2-7/16	5	4-15/16	5
1-5/8	3-3/16	1-5/16	1-9/16	1-15/16	5	3-15/16	4-3/16
1-3/4	2-5/8	11/16	13/16	1	4-7/16	1-15/16	2-1/8
1-7/8	2-1/16	0	0	0	3-7/16	0	0
2-1/4	5/16	0	0	0	1/2	0	0
2-5/16	0	0	0	0	0	0	0

Allowable Spray-Applied Fiber Insulation Thickness Over Joist

Installed SFRM Thickness (in.) on Joist	**SFRM Density (pcf)**					
	13	**15**	**22**	**22 (Type HP)**	**44**	**47**
9/16	5	5	5	5	5	5
13/16	5	5	5	5	5	5
1	5	5	5	5	5	5
1-1/8	5	5	5	5	5	5
1-1/4	5	5	5	5	5	5
1-3/8	5	4-11/16	5	5	5	5
1-9/16	5	3-11/16	5	5	5	5
1-3/4	5	2-11/16	3-15/16	5	5	5
2-1/16	5	1	1-1/2	5	5	5
2-1/4	5	0	0	5	5	5
3-1/4	2-1/16	0	0	3-7/16	0	0

MONOGLASS INC — Type Monoglass

7. **Shear Connector Studs —** (Optional) — Studs, 3/4 in. diam by 3 in. long, for 1-1/2 in. deep form units to 5-1/4 in. long for 3 in. deep form units, headed type or equivalent per AISC specifications. Welded to the top flange of the beam through the steel form units.

8. **Lath Hanger —** (Optional, Not Shown) For use in caged beams with Items 6, 6A or 6B Galv steel 6 SWG min diam spaced 27 in. O. C.

9. **Clips —** (Optional, Not Shown) For use in caged beams with Items 6, 6A or 6B No. 24 MSG spring steel pushed on to top and bottom flanges of beam spaced 6 in. O. C. max.

10. **Metal Lath —** (Optional, Not Shown) — For use in caged beams with Items 6, 6A or 6B 3/8 in. diamond mesh or rib lath, 3.4 lbs per sq yd expanded steel attached to beam with clips spaced 6 in. OC max; or tied to lath hangers with 18 SWG galv steel wire spaced 6 in. OC max.

11. **Electrical Inserts* —** (Not Shown) — Classified as "Outlet Boxes and Fittings Classified for Fire Resistance".

12. **Mineral and Fiberboards* —** (Optional, Not Shown. Not for use with Item 4A) — Applied over concrete floor with no restriction on board thickness. When mineral and fiber boards are used, the unrestrained beam rating shall be increased by a minimum of 1/2 hr.
See **Mineral and Fiber Board** (CERZ) category for names of manufacturers.

13. **Foamed Plastic* —** (Optional, Not Shown. Not for use with Item 4A) — Consisting of polyisocyanurate or urethane roof insulations. Applied over concrete floor with no restrictions on thickness. When polyisocyanurate or urethane insulation is used, the unrestrained beam rating shall be increased by a minimum of 1/2 hr.
See **Foamed Plastic** (CCVW) for list of manufacturers.

14. **Insulating Concrete —** (Optional, Not Shown) — Various types of insulating concrete prepared and applied as follows:
A. Vermiculite Concrete - Blend 6 to 8 cu ft of **Vermiculite Aggregate*** to 94 lb Portland cement and air entraining agent. Min thickness of 2 in. as measured to the top surface of the structural concrete or foamed plastic (Item 15) when it is used. See **Vermiculite Aggregate** (CJZZ) category for names of Classified companies.

B. Cellular **Concrete-Roof Topping Mixture*** - Concentrate mixed with water and Portland cement per manufacturer's specifications. Min. thickness of 2-in. as measured to the top surface of the structural concrete or foamed plastic (Item 15 and 15A) when used. Cast dry density and 28-day min compressive strength of 190 psi as determined with ASTM C495-66.

AERIX INDUSTRIES — Cast dry density of 37 (+ or -) 3.0 pcf

CELCORE INC — Type Celcore with cast dry density of 31 (+ or - 3.0) pcf or Type Celcore MF with cast dry density of 29 (+ or - 3.0) pcf

ELASTIZELL CORP OF AMERICA — Type II, with a cast dry density of 39 (+ or - 3.0) pcf

SIPLAST INC — Mix #1, Cast dry density of 32 (+ or -) 3 pcf

SIPLAST INC — Mix #2, Cast dry density of 36 (+ or -) 3 pcf

C. Cellular **Concrete-Roof Topping Mixture*** - Foam concentrate mixed with water, Portland cement and UL Classified Vermiculite Aggregate per manufacture's application instructions. Cast dry density of 33 (+ or -) 3 pcf and 28 day compressive strength of min 250 psi as determined in accordance with ASTM C495-86.

AERIX INDUSTRIES — Mix #3

ELASTIZELL CORP OF AMERICA — Type II. Mix #1 of cast dry density 39 (+ or -) 3.0 pcf, Mix #2 of cast dry density 40 (+ or -) 3.0 pcf, Mix #3 of cast dry density 47 (+ or -) 3.0 pcf

SIPLAST INC — Mix #3

D. Perlite Concrete - 6 cu ft of **Perlite Aggregate*** to 94 lb of Portland Cement and 1-1/2 pt air entraining agent. Min thickness 2 in. as measured to the top surface of structural concrete or foamed plastic (Item 15A) when it is used.

See **Perlite Aggregate** (CFFX) in Fire Resistance Directory for names of Classified companies.

15. **Foamed Plastic* —** (Optional, Not Shown) — For use only with vermiculite (Item 14A) or cellular (Item 14B) concretes-Rigid polystyrene foamed plastic insulation having slots and/or holes sandwiched between vermiculite concrete slurry which is applied to the normal or light weight concrete surface and vermiculite concrete topping (Item 14A).
See **Foamed Plastic*** (BRYX) category in Building Materials Directory or **Foamed Plastic*** (CCVW) Category in Fire Resistance Directory for list of Classified companies.

15A. **Foamed Plastic* —** (Not Shown) — For use only with cellular or perlite concrete. Nominal 24 by 48 in. polystyrene foamed plastic insulation boards having a density of 1.0 (+ or - 0.1) pcf, encapsulated within concrete topping. Each insulation board shall contain six nominal 3 in. diameter holes oriented in two rows of three holes each with the holes spaced 12 in. OC transversely and 16 in. OC longitudinally.
See **Foamed Plastic*** (BRYX) category in Building Materials Directory or Foamed Plastic* (CCYW) category in Fire Resistance Directory for list of Classified companies.

16. **Roof Covering Materials* —** (Optional, Not Shown) — Consisting of materials compatible with insulations described herein which provide Class A, B or C coverings.
See Built-Up Roof Covering Materials in Building Materials Directory.

17. **Insulated Concrete —** (Optional, Not Shown) — various types of insulated concrete prepared and applied in the thickness indicated.
A. **Vermiculite Concrete —** Mix consists of 6 cu ft of Vermiculite Aggregate*, 94 lbs of Portland cement and 6 ox of air entraining agent. Thickness to be 2 in min from the top plane of steel roof deck.
ELASTIZELL CORP OF AMERICA — Types MS16-U, MSV 200.

B. **Perlite Concrete —** Mix consists of 6.2 cu ft **Perlite Aggregate*** to 94 lbs of Portland cement and 1-1/2 pt air entraining agent. Compressive strength 80 psi min.
See **Perlite Aggregate** (CFFX) category for names of Classified companies.

18. **Wall and Partition Facings and Accessories —** (Optional, Not Shown) Sound barrier for use with Items 19, 20 or 21: Acoustic Sleeper Pads stapled or adhered to the underside of the subflooring panels spaced 24 in. OC.
STC ARCHITECTURAL PRODUCTS L L C DBA STC SOUND CONTROL — Acoustic Sleeper

19. **Structural Cement Fiber Units* —** (Optional, Not Shown) - (For use with item 18) - Min 3/4 in. thick tongue and groove structural cement fiber board loosely laid over concrete.
CORNERSTONE INNOVATIVE SPECIALTIES, LLC — Versaroc

UNITED STATES GYPSUM CO — Types STRUCTO-CRETE, USGSP

20. **Building Units* —** (Optional, Not Shown) - (For use with item 18) - Panels loosely laid over concrete.
DRAGONBOARD USA L L C — Type DragonBoard, DragonBoard Flooring

21. **Wood Structural Panels —** (Optional, Not Shown) - (For use with Item 18) - Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor," loosely laid over concrete, as one layer or as two layers.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2024-04-05

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

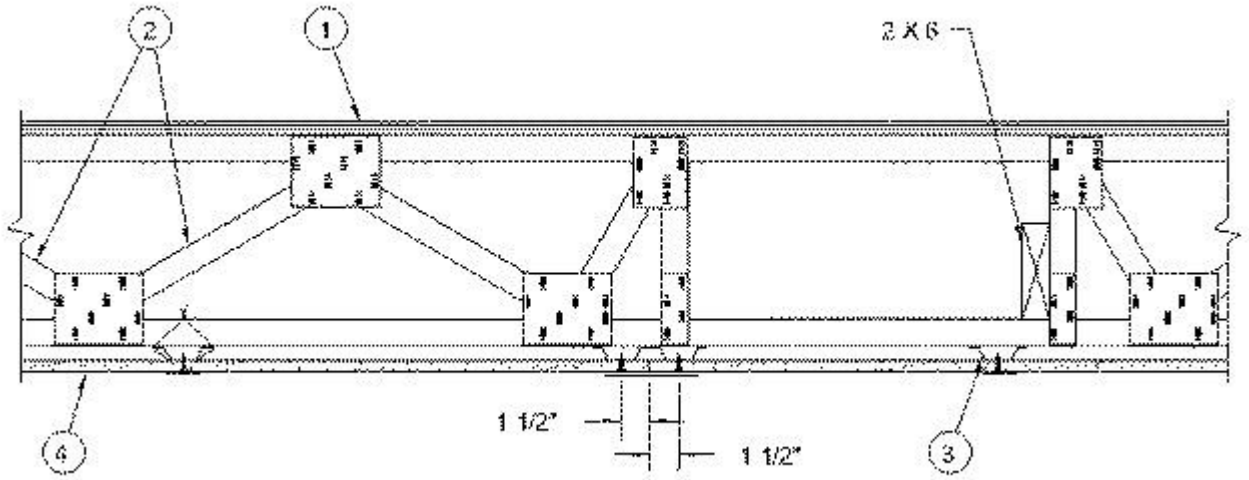
See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. **L528**

February 16, 2024

Unrestrained Assembly Rating - 1 Hr.
Finish Rating - 22 Min.
This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**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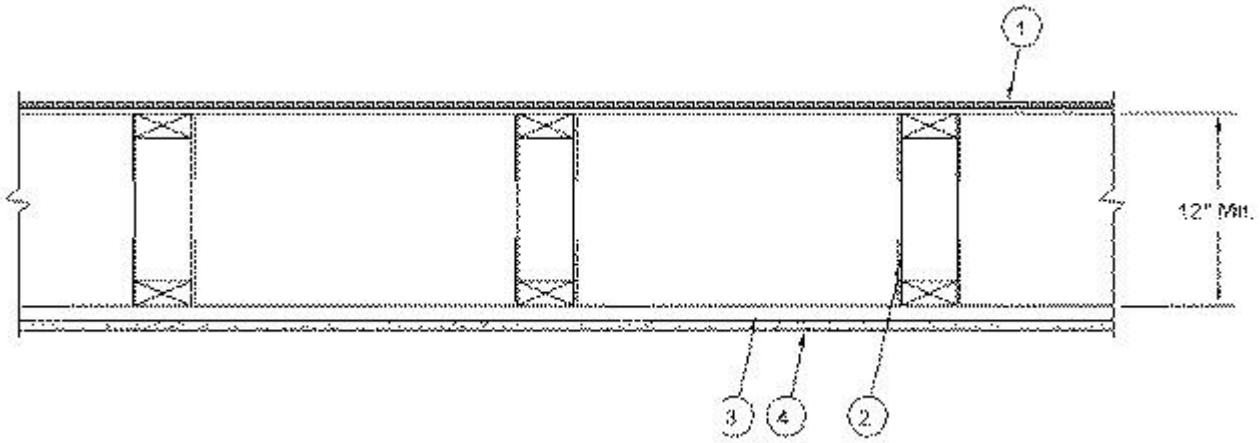
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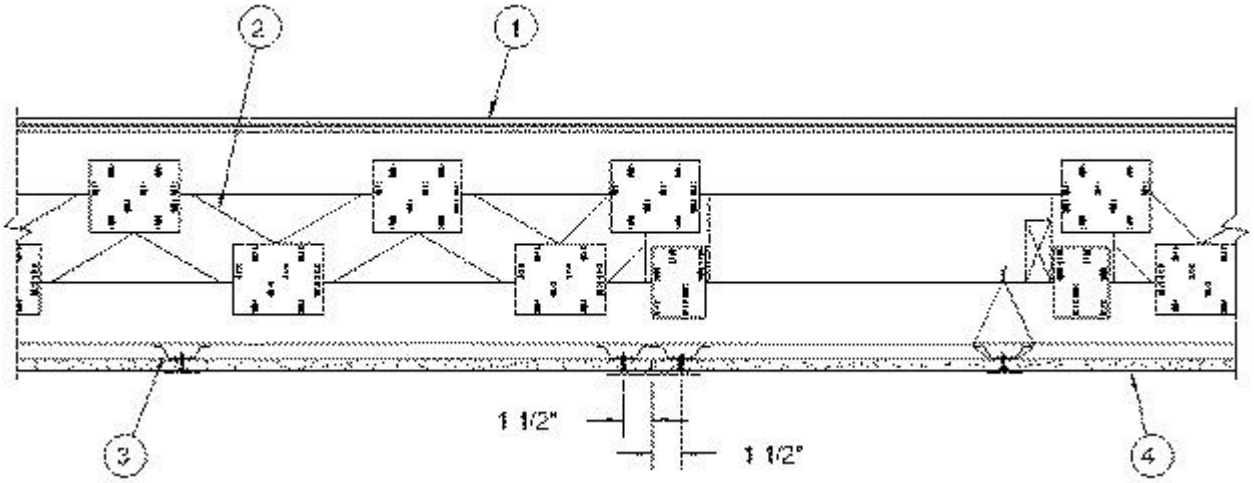
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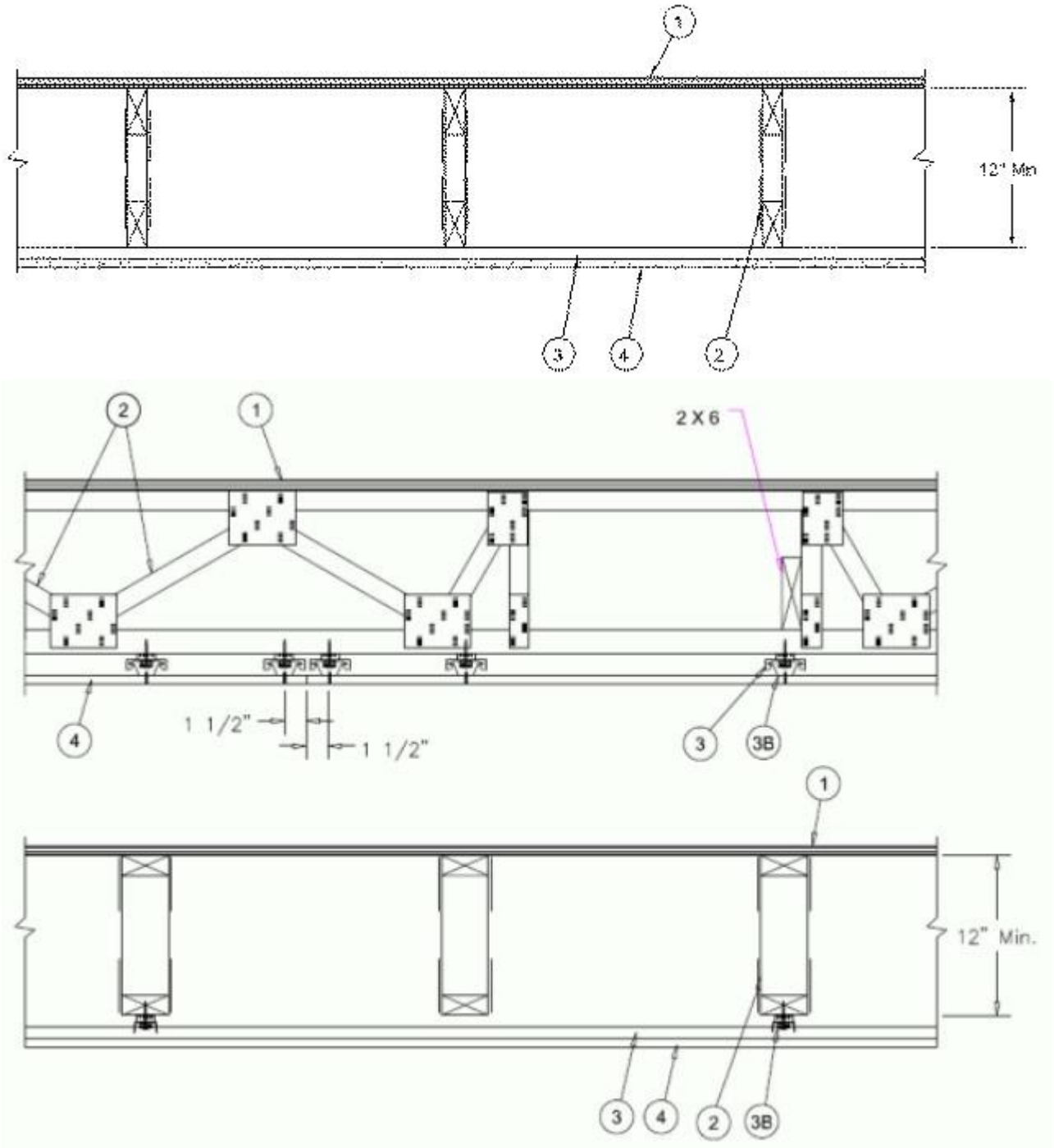


1. **Flooring System —** The flooring system shall consist of one of the following:

System No. 1

Subflooring — Min 23/32 in. thick T & G wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with end joints staggered 4 ft. Panels secured to trusses with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. TetraGRIP™ nails measuring 2-3/8 in. long, 0.113 in. diameter, 0.272 in. round head, and helically threaded shank with barbed features on the helix meeting ASTM F1667 and having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.

System No. 2

Subflooring — Min 23/32 in. thick T & G wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with end joints staggered 4 ft. Panels secured to trusses with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. TetraGRIP™ nails measuring 2-3/8 in. long, 0.113 in. diameter, 0.272 in. round head, and helically threaded shank with barbed features on the helix meeting ASTM F1667 and having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.030 in. thick.

Vapor Barrier — (Optional) — Nom 0.010 in. thick commercial rosin-sized building paper.

Finish Flooring — Min 3/4 in. thickness of lightweight insulating concrete with **Perlite Aggregate*** or **Vermiculite Aggregate***, or gypsum concrete.

See **Perlite Aggregate** (CFFX) and **Vermiculite Aggregate** (CJZZ) categories for names of manufacturers.

System No. 3

Subflooring — Min 23/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with joints staggered.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.030 in. thick.

Floor Mat Materials* — (Optional)— Floor mat material nom 5/64 in. (2 mm) thick adhered to subfloor with Hacker Floor Primer. Primer to be applied to the surface of the mat prior to the placement of a min 1 in. of floor-topping mixture.

HACKER INDUSTRIES INC — Type Hacker Sound-Mat.

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 1/4 in. (6 mm) thick adhered to subfloor with Hacker Floor Primer. Primer to be applied to the surface of the mat prior to the placement of a min 1-1/4 in. (32 mm) of floor-topping mixture.

HACKER INDUSTRIES INC — Type Hacker Sound-Mat II.

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 1/8 in. (3 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 3/4 in. (19 mm)

HACKER INDUSTRIES INC — FIRM-FILL SCM 125

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 1/4 in. (6 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1 in. (25 mm)

HACKER INDUSTRIES INC — Type FIRM-FILL SCM 250, Quiet Qurl 55/025

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 3/8 in. (10 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1-1/4 in. (32 mm)

HACKER INDUSTRIES INC — FIRM-FILL SCM 400, Quiet Qurl 60/040

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 3/4 in. (19 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1-1/2 in. (38 mm)

HACKER INDUSTRIES INC — Type FIRM-FILL SCM 750, Quiet Qurl 65/075

Metal Lath — (Optional) — For use with 3/8 in. (10 mm) floor mat materials, 3/8 in. expanded steel diamond mesh, 3.4 lbs/sq yd placed over the floor mat material. Hacker Floor Primer to be applied prior to the placement of the metal lath. When metal lath is used, floor topping thickness a nom 1-1/4 in. over the floor mat.

Finish Flooring — Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture having a min compressive strength of 1100 psi. Mixture shall consist of 6.8 gal of water to 80 lbs of floor topping mixture to 1.9 cu ft of sand.

HACKER INDUSTRIES INC — Firm-Fill Gypsum Concrete, Firm-Fill 2010, Firm-Fill 3310, Firm-Fill 4010, Firm-Fill High Strength, Gyp-Span Radiant

System No. 4

Subflooring — Min 23/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with joints staggered.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.010 in. thick.

Finish Flooring — Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture having a minimum compressive strength of 1800 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.

UNITED STATES GYPSUM CO — Types LRK, HSLRK, CSD

LATICRETE SUPERCAP L L C — Types LRK, HSLRK

USG MEXICO S A DE C V — Types LRK, HSLRK, CSD

Floor Mat Materials* — (Optional) — Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.

UNITED STATES GYPSUM CO — Types SAM, LEVELROCK® Brand Sound Reduction Board, LEVELROCK® Brand Floor Underlayment SRM-25

Alternate Floor Mat Materials* — (Optional) — Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding minimum thickness of floor topping over floor mat.

GRASSWORX L L C — SC Types

Alternate Floor Mat Material* — (Optional) - Floor mat material nominal 3/8 in. thick loose laid over the subfloor. Floor topping shall be a min 3/4 in. thick.

System No. 5

Subflooring — Min 23/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with joints staggered.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.030 in. thick.

Finish Flooring — Floor Topping Mixture* — Min 1-1/2 in. thickness of floor topping mixture having a min compressive strength of 1000 psi and a cast density of 100 plus or minus 5 pcf. Foam concentrate mixed 40:1 by volume with water and expanded at 100 psi through nozzle. Mixture shall consist of 1.4 cu feet of preformed foam concentrate to 94 lbs Type I Portland cement, 300 lbs of sand with 5-1/2 gal of water.

ELASTIZELL CORP OF AMERICA — Type FF

System No. 6

Subflooring — Min 23/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with joints staggered.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.030 in. thick.

Finish Flooring — Floor Topping Mixture* — Min 1-1/2 in. thickness of floor topping mixture having a min compressive strength of 1000 psi and a cast density of 100 plus or minus 5 pcf. Foam concentrate mixed 40:1 by volume with water and expanded at 100 psi through nozzle. Mixture shall consist of 1.2 cu feet of preformed foam concentrate to 94 lbs Type I Portland cement, 300 lbs of sand with 5-1/2 gal of water.

AERIX INDUSTRIES — Floor Topping Mixture

System No. 7

Deleted.

System No. 8

Subflooring — Min 23/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with joints staggered.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.030 in. thick.

Finish Flooring - Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture having a minimum compressive strength of 1500 psi. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.

MAXXON CORP — Types Maxxon Standard and Maxxon High Strength

Floor Mat Materials* — (Optional) - Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.

MAXXON CORP — Type Encapsulated Sound Mat.

Floor Mat Reinforcement — (Optional) - Refer to manufacturer's instructions regarding minimum thickness of floor topping for use with floor mat reinforcement.

Metal Lath — (Optional) - 3/8 in. expanded galvanized steel diamond mesh, 3.4 lbs/sq yd loose laid over the floor mat material.

Fiber Glass Reinforcement - (Optional, Not Shown) - 0.015 in. thick PVC coated non-woven fiberglass mesh, 0.368 lbs/sq yd loose laid over the floor mat material.

System No. 9

Subflooring — Min 23/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with joints staggered.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.030 in. thick.

Finish Flooring — Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture having a min compressive strength of 1000 psi. Mixture shall consist of 5 to 8 gal of water to 80 lbs of floor topping mixture to 2.1 cu ft of sand. Refer to the manufacturer's instructions accompanying the material and/or contact the manufacturer's technical support for specific mix design and minimum thickness recommended for use with eligible floor mat(s).

ULTRA QUIET FLOORS — UQF-A, UQF-Super Blend, UQF-Plus 200

System No. 10

Subflooring — Min 23/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with joints staggered.

Vapor Barrier — (Optional) Commercial asphalt saturated felt, 0.030 in. thick.

Finish Flooring — Floor Topping Mixture* — Min 3/4 in. thickness of floor topping having a min compressive strength of 1000 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.

FORMULATED MATERIALS LLC — Types FR-25, FR-30, and SiteMix

Alternate Floor Mat Material* — (Optional) Floor mat material nominal 2 - 9.5 mm thick loose laid over the subfloor. Floor topping shall be a min of 3/4 in.

FORMULATED MATERIALS LLC — Types M1, M2, M3, Elite, Duo, R1, and R2

System No. 11

Subflooring — Min 1 by 6 in. T & G lumber fastened diagonally to trusses, or min 15/32 in. thick plywood or min 7/16 in. thick oriented strand board (OSB) wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered.

Finish Floor - Mineral and Fiber Board* — Min 1/2 in. thick, supplied in sizes ranging from 3 ft by 4 ft to 8 ft by 12 ft. All joints to be staggered a min of 12 in. with adjacent sub-floor joints.

HOMASOTE CO — Type 440-32 Mineral and Fiber Board

System No. 12

Subflooring — Min 23/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with joints staggered.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.030 in. thick.

Finish Flooring — Floor Topping Mixture* — Min 3/4 in. thickness of floor topping having a min compressive strength of 1000 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.

ARCOSA SPECIALTY MATERIALS — AccuCrete® Types NexGen, Green, Prime and PrePour, AccuRadiant®, AccuLevel® Types G40, G50 and SD30

Alternate Floor Mat Material* — (Optional) — Floor mat material nominal 2 - 9.5 mm thick loose laid over the subfloor. Floor topping shall be a min of 3/4 in.

ARCOSA SPECIALTY MATERIALS — AccuQuiet® Types D13, D-18, D25, DX38, EM.125, EM.125S, EM.250, EM.250S, EM.375, EM.375S, EM.750, and EM.750S.

System No. 13

Subflooring — Min 15/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the joists with joints staggered.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.030 in. thick.

Vapor Barrier — (Optional) — Nom 0.010 in. thick commercial rosin-sized building paper.

Finish Flooring* — Min 3/4 in. thickness of any Floor Topping Mixture bearing the UL Classification Marking as to Fire Resistance. See **Floor- and Roof-Topping Mixtures** (CCOX) category for names of Classified Companies.

Floor Mat Materials* — (Optional) — Nom. 1/4 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 3/4 in.

KEENE BUILDING PRODUCTS CO INC — Type Quiet Qurl 55/025 and Quiet Qurl 55/025 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 3/8 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 1 in.

KEENE BUILDING PRODUCTS CO INC — Type Quiet Qurl 60/040 and Quiet Qurl 60/040 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 3/4 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 1-1/2 in.

KEENE BUILDING PRODUCTS CO INC — Type Quiet Qurl 65/075, Quiet Qurl 65/075 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 1/8 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 3/4 in.

KEENE BUILDING PRODUCTS CO INC — Type Quiet Qurl 52/013 and Quiet Qurl 52/013 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 1/4 in. entangled net core with a compressible fabric attached to the bottom loose laid over the subfloor. Floor topping thickness shall be a minimum of 1 in.

KEENE BUILDING PRODUCTS CO INC — Quiet Qurl 55/025 MT and Quiet Qurl 55/025 N MT

System No. 14

Subflooring — Min 23/32 in. thick T&G wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with end joints staggered 4 ft. Panels secured to trusses with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. TetraGRIP™ nails measuring 2-3/8 in. long, 0.113 in. diameter, 0.272 in. round head, and helically threaded shank with barbed features on the helix meeting ASTM F1667 and having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.

Gypsum Board* — One layer of nom 5/8 in. thick, 4 ft wide gypsum board, installed with long dimension perpendicular to joists. Gypsum board secured with 1 in. long No. 6 Type W bugle head steel screws spaced 12 in. OC and located a min of 1-1/2 in. from side and end joints. The joints of the gypsum board are to be staggered a minimum of 12 inches from the joints of the subfloor.

GEORGIA-PACIFIC GYPSUM L L C — Type DS

Floor Mat Materials* — (As an alternate to the single layer gypsum board) — Floor mat material loose laid over the subfloor.

MAXXON CORP — Type Encapsulated Sound Mat.

Gypsum Board* — (For use when floor mat is used) Two layers of nom 5/8 in. thick, 4 ft wide gypsum board, installed with long dimension perpendicular to joists on top of the floor mat material. Gypsum board secured to each other with 1 in. long No. 6 Type G bugle head steel screws spaced 12 in. OC and located a min of 1-1/2 in. from side and end joints. The joints of the gypsum board are to be staggered a minimum of 12 inches in between layers and from the joints of the subfloor.

GEORGIA-PACIFIC GYPSUM L L C — Type DS

System No. 15

Subflooring — Min 23/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with joints staggered.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.030 in. thick.

Finish Flooring - Floor Topping Mixture* — Min 3/4 in. thickness of floor topping having a min compressive strength of 1000 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.

DEPENDABLE LLC — GSL M3.4, GSL K2.6, GSL-CSD, GSL RH and SKIMFLOW

Floor Mat Materials* — (Optional) — Nom. 1/4 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 3/4 in.

KEENE BUILDING PRODUCTS CO INC — Type Quiet Qurl 55/025 and Quiet Qurl 55/025 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 3/8 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 1 in.

KEENE BUILDING PRODUCTS CO INC — Type Quiet Qurl 60/040 and Quiet Qurl 60/040 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 3/4 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 1-1/2 in.

KEENE BUILDING PRODUCTS CO INC — Type Quiet Qurl 65/075, Quiet Qurl 65/075 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 1/8 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 3/4 in.

KEENE BUILDING PRODUCTS CO INC — Type Quiet Qurl 52/013 and Quiet Qurl 52/013 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 1/4 in. entangled net core with a compressible fabric attached to the bottom loose laid over the subfloor. Floor topping thickness shall be a minimum of 1 in.

KEENE BUILDING PRODUCTS CO INC — Quiet Qurl 55/025 MT and Quiet Qurl 55/025 N MT

System No. 16

Subflooring — Min 23/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the joists with joints staggered.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.030 in. thick.

Vapor Barrier — (Optional) — Nom 0.010 in. thick commercial rosin-sized building paper.

Finish Flooring* — Min 3/4 in. thickness of any Floor Topping Mixture bearing the UL Classification Marking as to Fire Resistance. See **Floor- and Roof-Topping Mixtures** (CCOX) category for names of Classified Companies. Refer to the manufacturer's instructions accompanying the material and/or contact the manufacturer's technical support for specific mix design and minimum thickness recommended for use with eligible floor mat(s).

Floor Mat Materials* — (Optional) — Nom 3/32 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 3/4 in.

PLITEQ INC — Type GenieMat RST02

Floor Mat Materials* — (Optional) — Nom 3/16 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 3/4 in.

PLITEQ INC — Type GenieMat FF03NP

Floor Mat Materials* — (Optional) — Nom 1/4 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 3/4 in.

PLITEQ INC — Type GenieMat FF06

Floor Mat Materials* — (Optional) — Nom 3/8 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 1 in.

PLITEQ INC — Type GenieMat FF10

Floor Mat Materials* — (Optional) — Nom 3/4 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 1-1/2 in.

PLITEQ INC — Type GenieMat FF17

Floor Mat Materials* — (Optional) — Nom 1 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 1-1/2 in.

PLITEQ INC — Type GenieMat FF25

System No. 17

Subflooring — Nom. 1-1/2 in. thick T & G laminated composite plywood sub-floor panels to be perpendicular to the trusses with end joints staggered 4 ft. End joints centered over top chord of trusses. Subfloor panels secured to trusses with construction adhesive and #8 by 3 in. wood screws spaced 12 in. OC in the field and 6 in. OC at the end joints.
RSP INDUSTRIES INC — SAP board

System No. 18

Subflooring — Min 15/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Panels secured to trusses with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss.

Wall and Partition Facings and Accessories* - Sound Barrier (Optional) — Acoustic Sleeper pads stapled to the top of the subfloor, the bottom of the finish floor, or to 5/16 in. thick by 1-1/2 in. wide wood strips and centered over wood trusses. Acoustic Sleeper pads are to be spaced appropriately so that the finish floor panels are fastened through Acoustic Sleeper pads to the trusses.
STC ARCHITECTURAL PRODUCTS L L C DBA STC SOUND CONTROL — Acoustic Sleeper

Finish Floor — Min 23/32 in. thick T & G wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with end joints staggered 4 ft. Butt joints of panels have the option of being sealed with any UL Classified caulk or sealant found under - Fill, Void or Cavity Materials* (XHHW).

System No. 19

Structural Cement-Fiber Units* — For use with **UNITED STATES GYPSUM CO** Types C, IP-X2, IPC-AR and ULIX or AMERICAN GYPSUM CO Type AG-C. gypsum boards only. Nom 3/4 in. thick, with long edges tongue and grooved. Long dimension of panels to be perpendicular to wood trusses with end joints staggered a min of 2 ft and centered over the trusses. Panels secured to wood trusses with 1-5/8 in. long, No. 8, self- countersinking wood screw spaced a max of 12 in. OC in the field with a screw located 1 in. and 2 in. from each edge, and 8 in. OC on the perimeter with a screw located 2 in. from each edge, located 1/2 in. from the end edges of the panel.
UNITED STATES GYPSUM CO — Types STRUCTO-CRETE, USGSP

System No. 20

Subflooring — Min 23/32 in. thick T & G wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with end joints staggered 4 ft. Panels secured to trusses with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. TetraGRIP™ nails measuring 2-3/8 in. long, 0.113 in. diameter, 0.272 in. round head, and helically threaded shank with barbed features on the helix meeting ASTM F1667 and having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.

Finish Flooring - Floor Topping Mixture* — Min 1 in. thickness of floor topping mixture having a min compressive strength of 4500 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.
SIKA DEUTSCHLAND GMBH — Type SCHONOX AP Rapid Plus

System No. 21

Subflooring — Min 23/32 in. thick T & G wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with end joints staggered 4 ft. Panels secured to trusses with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. TetraGRIP™ nails measuring 2-3/8 in. long, 0.113 in.

diameter, 0.272 in. round head, and helically threaded shank with barbed features on the helix meeting ASTM F1667 and having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.

Vapor Barrier — (Optional) - Commercial asphalt saturated felt, 0.030 in. thick.

Vapor Barrier — (Optional) - Nom 0.010 in. thick commercial rosin-sized building paper.

Finish Flooring - Floor Topping Mixture* — Min 3/4 in. thickness of any Floor Topping Mixture bearing the UL Classification Marking as to Fire Resistance. See Floor- and Roof-Topping Mixtures (CCOX) category for names of Classified Companies. Refer to the manufacturer's instructions accompanying the material and/or contact the manufacturer's technical support for specific mix design and minimum thickness recommended for use with eligible floor mat(s).

Floor Mat Materials* — (Optional, Not Shown) - Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.
LOW & BONAR INC — EnkaSonic® by Colbond a member of the Low & Bonar group Types 125, 250, 250 Plus, 400, 400 Plus, 750, and 750 Plus.

Floor Mat Reinforcement — (Optional) - Refer to manufacturer's instructions regarding minimum thickness of floor topping for use with floor mat reinforcement.

Metal Lath — (Optional) — Expanded steel diamond mesh, 2.5 lb / sq yd loose laid over floor mat material.

Fiberglass Mesh Reinforcement — (Optional) — Coated non-woven glass fiber mesh grid loose laid over floor mat material.

System No. 22

Subflooring — Min 23/32 in. thick T & G wood structural panels described and installed as shown in System No. 1.

Finish Floor - Building Units* — Min 1/2 in. thick magnesium oxide panels installed parallel, perpendicular, or diagonally to trusses with panel edges offset a min of 4 in. between subfloor and magnesium oxide panels. Panels secured to subfloor with construction adhesive and corrosion resistant fasteners, spaced 12 in. OC around the perimeter and in the field of the panel. Fasteners must be placed no closer than 1/2 in. from all panel edges and no closer than 2 in. from panel corners
HUBER ENGINEERED WOODS L L C — Type 1/2 in. Square Edge Exacor™ Board

System No. 23

Subflooring — Min 15/32 in. thick wood structural panels, min grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with joints staggered. Fastened with 8d ringed shank nails spaced 12 in. OC along each truss.

Finish Floor - Building Units* — Min 1/2 in. thick, supplied in 4 by 8 ft panels, fastened to trusses through subfloor with 8d ringed shank nails spaced a max of 12 in. OC. All joints to be staggered a min of 12 in. with adjacent sub-floor joints.
ECTEK INTERNATIONAL INC — Type MegaBoard, 1/2 in. thick

System No. 24

Subflooring — Building Units* — Nom 3/4 in. thick, tongue and grooved boards. Long dimension of boards to be perpendicular to wood trusses with end joints staggered a min of 4 ft. and centered over the trusses. Boards secured to trusses with min 2 in. long screws or 2 in. x 0.113 in. Ring Shank nails spaced a max of 12 in. OC in the field with screws/nails located 1 in. from long edge, and max 8 in. OC along the end joints with screws/nails located 1/2 in. from end joint.

ECTEK INTERNATIONAL INC — Type MegaBoard, 3/4 in. thick

Finish Floor (optional) — Building Units* — Min 1/2 in. thick, supplied in 4 by 8 ft panels, fastened to trusses through subfloor with 2-3/8 in. long 8d ringed shank nails spaced a max of 12 in. OC. All joints to be staggered a min of 12 in. with adjacent sub-floor joints.

ECTEK INTERNATIONAL INC — Type MegaBoard, 1/2 in. thick

System No. 25

Subflooring — Min 23/32 in. thick T & G wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with end joints staggered 4 ft. Panels secured to trusses with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. TetraGRIP™ nails measuring 2-3/8 in. long, 0.113 in. diameter, 0.272 in. round head, and helically threaded shank with barbed features on the helix meeting ASTM F1667 and having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.

Vapor Barrier — (Optional) — Nom 0.030 in. thick commercial asphalt saturated felt.

Floor Mat Materials* — (Optional) — Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.

GRASSWORX L L C — SC Types

Finish Flooring* — Min 3/4 in. thickness of any Floor Topping Mixture bearing the UL Classification Marking as to Fire Resistance. See Floor- and Roof-Topping Mixtures (CCOX) category for names of Classified Companies. Refer to the manufacturer's instructions accompanying the material and/or contact the manufacturer's technical support for specific mix design and minimum thickness recommended for use with eligible floor mat(s).

Floor Mat Reinforcement — (Optional) - Refer to manufacturer's instructions regarding minimum thickness of floor topping for use with floor mat reinforcement.

Metal Lath — (Optional) — Expanded steel diamond mesh, 2.5 lb / sq yd loose laid over floor mat material.

Fiberglass Mesh Reinforcement — (Optional) — Coated non-woven glass fiber mesh grid loose laid over floor mat material.

System No. 26

Subflooring – Building Units* — Nom 3/4 in. thick, ship-lap or tongue-in-groove edge detail. Long dimension of boards to be perpendicular to trusses with end joints staggered a min of 4 ft. and centered over the trusses. Boards secured to trusses with #8 x 2 in. long screws or 2 in. long by 0.113 in. ring shank nails spaced a max of 12 in. OC in the field and 8 in. OC along butt ends. Fasteners located 1/2 in. from butt edges and 2 in. from long edges of the board. When Finish Floor (see below) is not used, must be used with Item 7I).

AMERIFORM L L C — Type Nocom

Finish floor – (Optional) - Min 1/2 in. thick, supplied in 4 ft by 8 ft panels, installed perpendicular or parallel to trusses with panel edges offset a min of 24 in. with adjacent sub-floor joints. Panels secured to subfloor with construction adhesive and corrosion resistant fasteners spaced a max of 12 in. OC. around perimeter and in the field of the panel. Fasteners located 1/2 in. at butt edges and 2 in. from long edge of the boards.

MULTI-PANELS – Type M4 Panel

System No. 27

Subflooring Min 23/32 in. thick T & G wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panels to be perpendicular to the trusses with end joints staggered 4 ft. Panels secured to trusses with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. TetraGRIP™ nails measuring 2-3/8 in. long, 0.113 in. diameter, 0.272 in. round head, and helically threaded shank with barbed features on the helix meeting ASTM F1667 and having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.

Finish Floor – Building Units* - (Optional) - Min 1/2 in. thick, supplied in 4 ft by 8 ft panels, installed perpendicular or parallel to trusses with panel edges offset a min of 24 in. with adjacent sub-floor joints. Panels secured to subfloor with construction adhesive and corrosion resistant fasteners s spaced a max of 12 in. OC. around perimeter and in the field of the panel. Fasteners located 1/2 in. at butt edges and 2 in. from long edges of the board.

MULTI-PANELS – Type M4 Panel

2. **Trusses —** Parallel chord trusses, spaced a max 24 in. OC, fabricated from nom 2 by 4 in. lumber with lumber oriented vertically or horizontally. Min truss depth is 12 in. when item 9 is not employed. Min truss depth is 18 in. when item 9 is employed. Truss members secured together with min No. 20 MSG galv steel truss plates. Plates have 5/16 in. long teeth projecting perpendicular to the plane of the plate. The teeth are in pairs facing each other (made by the same punch), forming a split-tooth-type plate. Each tooth has a chisel point on its outside edge. These points are diagonally opposite each other for each pair. The top half of each tooth has a twist for stiffness. The pairs are repeated on approx 7/8 in. centers with four rows of teeth per in. of plate width.

3. **Furring Channels —** Hat channels, 7/8 in. deep by 2-9/16 in. or 2-11/16 in. or 2-23/32 in. wide at the base and 1-7/16 in. wide at the face, formed from No. 25 ga galv steel, spaced 24 in. OC perpendicular to trusses. Channels secured to trusses with double strand of No. 18 SWG galv steel wire spaced 48 in. OC. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. Two furring channels used at end joints of gypsum board (Item 4), each extending a min of 6 in. beyond both side edges of the board.

3A. **Resilient Channels —** (Not Shown) — As an alternate to Item 3, resilient channel formed from No. 26 MSG galv steel, spaced 16 in. OC perpendicular to trusses. Channels secured to each truss with 1-1/4 in. long No. 6 Type S bugle head steel screw. Channels overlapped at splices 4 in. Two resilient channels used at end joints of gypsum board (Item 4), each extending a min of 6 in. beyond both side edges of the board.

3B. **Steel Framing Members* —** (Optional)— Used as an alternate method to attach furring channels to trusses (Item 2). Clips spaced 48 in. OC. RSIC-1 and RSIC-1 (2.75) clips secured to the bottom chord of alternating trusses with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. RSIC-V and RSIC-V (2.75) clips secured to the bottom chord of alternating trusses with No. 8 x 1-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips. RSIC-1 and RSIC-V clips for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) and RSIC-V (2.75) clips for use with 2-23/32 in. wide furring channels. Adjoining channels are overlapped as described in Item 3. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two min 7/16 in. long No. 6 self-tapping framing screws, at the midpoint of the overlap, with one screw on each flange of the channel. Additional clips required to hold furring channel that supports the gypsum board butt joints, as described in Item 4. When Fiber, Sprayed (Item 6) is used, furring channel spacing reduced to 16 in. OC and two layers of nom 5/8 in. thick, 4 ft wide gypsum board shall be installed as described in Item 4.
PAC INTERNATIONAL L L C — Types RSIC-1, RSIC-V, RSIC-1 (2.75), RSIC-V (2.75)

3C. **Steel Framing Members* —** (Optional, Not Shown) — Used as an alternate method to attach furring channels to trusses. Clips spaced 48 in. OC., and secured to the bottom chord to alternating trusses with two No. 8 x 2-1/2 in. coarse drywall screws, one through the hole at each end of the clip. Furring channels are friction fitted into clips. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. Additional clips required to hold furring channel that supports the gypsum board butt joints, as described in Item 4. Two layers of gypsum board required as described in Item 4. Not evaluated for use with Item 6. When Item 3C is used and Batts and Blankets* are added per Section III Item 18 Blanket Insulation in the General Information of this Directory (BXUV), clips spaced 48 in. OC, furring channels spaced 16 in. OC max, 3-1/2 in. max. Batts and Blankets* secured to plywood subfloor with staples spaced 12 in. OC or to the trusses with 0.090 in. diam galv steel wires spaced 12 in. OC, and two layers of gypsum board required as described in Item 4A. When the Batts and Blankets* are draped over the furring channel/gypsum panel ceiling membrane, the clip spacing shall be reduced to 24 in. OC and secured to consecutive trusses, the furring channel spacing shall be reduced to 12 in. OC, and two layers of gypsum board required as described in Item 4A.
KINETICS NOISE CONTROL INC — Type Isomax.

3D. **Steel Framing Members* —** (Optional, Not Shown) — For Use with Item 7- Used as an alternate method to attach furring channels to trusses. Clips spaced 48 in. OC. and secured to the bottom chord to alternating trusses with one No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. Additional clips required to hold furring channel that supports the gypsum board butt joints, as described in Item 4. Not evaluated for use with Item 6.
PLITEQ INC — Type Genie Clip

3E. **Steel Framing Members* —** (Optional, Not Shown) — For use with Item 7B - Used as an alternate method to attach furring channels to trusses. Clips spaced at 48" OC and secured to the bottom of the trusses with one 2 in. Coarse Drywall Screw with 1 in. diam. washer through the center hole. Furring channels are then friction fitted into clips. Ends of channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire .Additional clips are required to hold the Gypsum Butt joints as described in item 4. Not evaluated for use with Item 6.
STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237 or A237R

3F. **Resilient Channels —** For use with Item 4B and 7A - Resilient channels, formed from No. 25 MSG galv steel and shaped as shown, spaced 12 in. OC perpendicular to joist. Channels overlapped 4 in. at splices and secured to each joist with 1-1/4 in. Type S screws. Min end clearance of channels to wall to be 1/2 in. Additional resilient channels positioned so as to coincide with end joints of gypsum board.

3G. **Resilient Channels —** For Use With Item 4C and 7C. Formed from min 25 MSG galv steel installed perpendicular to trusses and spaced 16 in. OC. Channels secured to each truss with 1-5/8 in. long Type S bugle head steel screws. Channels overlapped 4 in. at splices. Two channels, spaced 6 in. OC, oriented opposite each gypsum panel end joint. Additional channels shall extend min 6 in. beyond each side edge of panel. Insulation, Item 7C is applied over the resilient channel/gypsum panel ceiling membrane.

3H. **Steel Framing Members* —** (Optional, Not Shown) — Used as an alternate method to attach furring channels to trusses. Clips spaced at 48" OC and secured to the bottom of the trusses with one 2-1/2 in. Coarse Drywall Screw with 1 in. diam. washer through the center hole. Furring channels are then friction fitted into clips. Ends of channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire .Additional clips are required to hold the Gypsum Butt joints as described in item 4. Not evaluated for use with Item 6.
REGUPOL AMERICA — Type SonusClip

3I. **Steel Framing Members —** (Not Shown) — For use with Items 4C and 7F, As an alternate to Item 3, main runners, cross tees, cross channels and wall angle as listed below.

a. **Main Runners —** Nom 10 or 12 ft long, 15/16 in. or 1-1/2 in. wide face, spaced 4 ft. OC. Main runners suspended by min 12 SWG galv. steel hanger wires spaced 48 in. OC. Hanger wires to be located adjacent to main runner/cross tee intersections. Hanger wires wrapped and twist-tied on 16d nails driven in to side of trusses at least 5 in. above the bottom face.

b. **Cross Tees or Channels —** Nom 4 ft long cross tees, with 15/16 in. or 1-1/2 in. wide face, or nom 4 ft long cross channels, with 1-1/2 in. wide face, spaced 16 in. OC, installed perpendicular to the main runners. Additional cross tees or channels used 8 in. from each side of butted gypsum board end joints. The cross tees or channels may be riveted or screw-attached to the wall angle or channel to facilitate the ceiling installation.

c. **Wall Angle or Channel —** Painted or galv. steel angle with 1 in. legs or channel with 1 in. legs, 1-9/16 in. deep attached to walls at perimeter of ceiling with fasteners 16 in. OC. To support steel framing member ends and for screw-attachment of the gypsum panel.
USG INTERIORS LLC — Type DGL or RX

3J. **Steel Framing Members* —** (Optional, Not Shown) — Used to attach resilient channels (Item 3A) to trusses (Item 2). Clips spaced 48 in. OC on adjacent trusses, and secured to trusses with one No. 8 x 2-1/2 in. coarse drywall screw through center grommet hole. Channels secured to clips with one #10 x 1/2 in. pan-head self-drilling screw. Ends of adjoining channels overlapped 6 in. and secured together with two #8 15 x 1/2 in. Philips Modified Truss screws spaced 2-1/2 in. from the center of the overlap. Gypsum board butt joints require additional resilient channels spaced 1-1/2 in. from the butt joint on either side. One edge of the extra channels will extend to an adjacent truss where it is secured with a clip.
KEENE BUILDING PRODUCTS CO INC — Type RC+ Assurance Clip

3K. **Resilient Channels —** For use with items 3L, 4F, and 7G — Formed from min 26 MSG galv steel installed perpendicular to trusses. When Item 7G is draped over channels, channels spaced a maximum 12 in. OC. Channels secured to each truss as described in Item 3L. Channel ends butted and centered under the joists and attached to the joists with one screw at each end. Additional resilient channels positioned so as to coincide with end joints of gypsum board as shown in the above illustration. Additional channels shall extend min 3 in. beyond each side edge of board.

3L. **Steel Framing Members* —** (Optional, Not Shown) — Used as an alternate method to attach resilient channelsto joists (Item 2). For use with items 3K, 4F and 7G. A resilient sound isolation accessory shall be used at each attachment point of the resilient channels and spaced max 24 in. O.C. Channel ends butted and centered under the joists and attached to the joists with one accessory at each end. Additional accessories used to hold resilient channels that support the gypsum board end joints, as described in Item 3K. The accessory envelops the mounting edge of the resilient channel. The accessory and resilient channel are fastened to the joists with the screws supplied with the accessory and per the accessory manufacturer's installation instructions.
PAC INTERNATIONAL L L C — Types RC-1 Boost

3M. **Steel Framing Members* —** (Optional, Not Shown) — As an alternate to Item 3.
a. **Furring Channels —** Formed of No. 25 MSG galv steel, nominal 2-1/2 in. wide by 7/8 in. deep, spaced 24 in. OC, perpendicular to trusses. Channels secured to Cold Rolled Channels at every intersection with a 3/4 in. TEK screw through each furring channel leg. Ends of adjoining channels overlapped 12 in. and fastened together with two double strand No. 18 SWG galv steel wire ties, one at each end of overlap, or with two 3/4 in. TEK screws in each leg of the overlap section. Two furring channels used at end joints of gypsum board (Item 4), each extending a min of 6 in. beyond both side edges of the board.

b. **Cold Rolled Channels —** 1-1/2 in. by 1/2 in., formed from No. 16 ga. galv steel, positioned vertically and parallel to trusses, friction-fitted into the channel caddy on the Steel Framing Members (Item 3Md) and secured with two 3/4 in. TEK screws. Adjoining lengths of cold rolled channels lapped min. 12 in. and secured along bottom legs with four 3/4 in. TEK screws and wire-tied together with two double strand 18 SWG galv steel wire ties, one at each end of overlap.

c. **Blocking —** Where truss design does not permit direct, full contact of the hanger bracket, a piece of nominal 2 by 4 in. lumber (blocking), min. 12 in. long to permit full contact of the hanger bracket, to be secured vertically to the side of the trusses at the top and bottom of the blocking at each Steel Framing Member (Item 3Md) location with 16d nails or minimum 2-1/2 in. screws.

d. **Steel Framing Members* —** Spaced 48 in. OC. max along truss, and secured to the truss on alternating trusses with two, #10 x 1-1/2 in. screws through mounting holes on the hanger bracket.
PAC INTERNATIONAL L L C — Type RSIC-SI-CRC EZ Clip

3N. **Steel Framing Members* —** (Optional, Not Shown) — As an alternate to Item 3.
a. **Furring Channels —** Formed of No. 25 MSG galv steel, nominal 2-1/2 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to trusses and friction fit into Steel Framing Members (Item 3Nc). Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap or with two TEK screws along each leg of the 6 in. overlap. Two furring channels used at end joints of gypsum board (Item 4). Butt joint channels held in place by strong back channels placed upside down, on top of, and running perpendicular to primary furring channels, extending 6 in. longer than length of gypsum side joint. Strong back channels spaced maximum 48 in. OC. Strong back channels secured to every intersection of primary furring channels with four 7/16 in. pan head screws, two along each of the legs at intersections. Butt joint channels run perpendicular to strong back channels and shall be minimum 6 in. longer than length of joint, secured to strong back channels with 7/16 in. pan head screws, two along each of the legs at intersection with strong back channels.

b. **Blocking —** Where truss design does not permit direct, full contact of the hanger bracket, a piece of nominal 2 by 4 in. lumber (blocking), min. 12 in. long to permit full contact of the hanger bracket, to be secured vertically to the side of the trusses at the top and bottom of the blocking at each Steel Framing Member (Item 3Nc) location with 16d nails or minimum 2-1/2 in. screws.

c. **Steel Framing Members* —** Used to attach furring channels (Item 3Na) to trusses. Clips spaced 48 in. OC and secured along truss webs at each furring channel intersection with min. 3/4 in. long self-drilling #10 x 1-1/2 in. screws through each of the provided hole locations. Furring channels are friction fitted into clips.
PAC INTERNATIONAL L L C — Type RSIC-S1-1 Ultra

3O. **Resilient Channels —** For Use With Item 4G and 7C. Formed from min 25 MSG galv steel installed perpendicular to trusses and spaced 16 in. OC. Channels secured to each truss with 1-1/4 in. long Type S bugle head steel screws. Channels overlapped 4 in. at splices. Two channels, spaced 6 in. OC, oriented opposite each gypsum panel end joint. Additional channels shall extend min 6 in. beyond each side edge of panel. Insulation, Item 7C is applied over the resilient channel/gypsum panel ceiling membrane.

3P. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 3) — Furring channels and Steel Framing Members as described below:

A. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-23/32 in. wide by 7/8 in., spaced 24 in. OC max perpendicular to trusses. Channels secured to trusses as described in Item 3Pb. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Additional clips required to hold furring channel that supports the wallboard butt joints, as described in Item 4.

B. **Steel Framing Members* —** Used to attach furring channels (Item 3Pa) to trusses (Item 2). Clips spaced 48 in. OC max with No. 8 x 2-1/2 in. course drywall screw through the center grommet. Furring channels are friction fitted into clips.

CLARKDIETRICH BUILDING SYSTEMS — Type ClarkDietrich Sound Clips

3Q. **Steel Framing Members* —** (Optional, Not Shown) — Used as an alternate method to attach resilient channels (items 3 and 3G) to joists (Item 2). For use with items 3K, 4F and 7G. A resilient sound isolation accessory shall be used at each attachment point of the resilient channels and spaced max 24 in. O.C. Channel ends butted and centered under the joists and attached to the joists with one accessory at each end. Additional accessories used to hold resilient channels that support the gypsum board end joints, as described in Item 3K. The accessory envelops the mounting edge of the resilient channel. The accessory and resilient channel are fastened to the joists with the 2in. screws supplied with the accessory and per the accessory manufacturer's installation instructions.

PAC INTERNATIONAL L L C — Types RC-1 Boost

3R. **Steel Framing Members*** — (Optional) — As an alternate to Item 3G — Used as an alternate method to attach furring channels to trusses (Item 2). Clips spaced 48 in. OC. RSIC-1 and RSIC-1 (2.75) clips secured to the bottom chord of alternating trusses with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. RSIC-1 and RSIC-V clips for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) clips for use with 2-23/32 in. wide furring channels. Adjoining channels are overlapped as described in Item 3. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two min 7/16 in. long No. 6 self-tapping framing screws, at the midpoint of the overlap, with one screw on each flange of the channel. Additional clips required to hold furring channel that supports the gypsum board butt joints, as described in Item 4. When Fiber, Sprayed (Item 6) is used, furring channel spacing reduced to 16 in. OC and two layers of nom 5/8 in. thick, 4 ft wide gypsum board shall be installed as described in Item 4.

PAC INTERNATIONAL L L C — Types RSIC-1, RSIC-1 (2.75), RSIC-SI-X.

3S. **Steel Framing Members*** — (Optional, Not Shown) — As an alternate to Item 3G.

a. **Furring Channels** — Formed of No. 25 MSG galv steel, nominal 2-1/2 in. wide by 7/8 in. deep, spaced 24 in. OC, perpendicular to trusses. Channels secured to Cold Rolled Channels at every intersection with a 3/4 in. TEK screw through each furring channel leg. Ends of adjoining channels overlapped 12 in. and fastened together with two double strand No. 18 SWG galv steel wire ties, one at each end of overlap, or with two 3/4 in. TEK screws in each leg of the overlap section. Two furring channels used at end joints of gypsum board (Item 4), each extending a min of 6 in. beyond both side edges of the board.

b. **Cold Rolled Channels** — 1-1/2 in. by 1/2 in., formed from No. 16 ga. galv steel, positioned vertically and parallel to trusses, friction-fitted into the channel caddy on the Steel Framing Members (Item 3Md) and secured with two 3/4 in. TEK screws. Adjoining lengths of cold rolled channels lapped min. 12 in. and secured along bottom legs with four 3/4 in. TEK screws and wire-tied together with two double strand 18 SWG galv steel wire ties, one at each end of overlap.

c. **Blocking** — Where truss design does not permit direct, full contact of the hanger bracket, a piece of nominal 2 by 4 in. lumber (blocking), min. 12 in. long to permit full contact of the hanger bracket, to be secured vertically to the side of the trusses at the top and bottom of the blocking at each Steel Framing Member (Item 3Md) location with 16d nails or minimum 2-1/2 in. screws.

d. **Steel Framing Members*** — Spaced 48 in. OC. max along truss, and secured to the truss on alternating trusses with two, #10 x 2in. screws through mounting holes on the hanger bracket.

PAC INTERNATIONAL L L C — Type RSIC-SI-CRC EZ Clip

3T. **Steel Framing Members*** — (Optional, Not Shown) — As an alternate to Item 3G.

a. **Furring Channels** — Formed of No. 25 MSG galv steel, nominal 2-1/2 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to trusses and friction fit into Steel Framing Members (Item 3Nc). Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap or with two TEK screws along each leg of the 6 in. overlap. Two furring channels used at end joints of gypsum board (Item 4). Butt joint channels held in place by strong back channels placed upside down, on top of, and running perpendicular to primary furring channels, extending 6 in. longer than length of gypsum side joint. Strong back channels spaced maximum 48 in. OC. Strong back channels secured to every intersection of primary furring channels with four 7/16 in. pan head screws, two along each of the legs at intersections. Butt joint channels run perpendicular to strong back channels and shall be minimum 6 in. longer than length of joint, secured to strong back channels with 7/16 in. pan head screws, two along each of the legs at intersection with strong back channels.

b. **Blocking** — Where truss design does not permit direct, full contact of the hanger bracket, a piece of nominal 2 by 4 in. lumber (blocking), min. 12 in. long to permit full contact of the hanger bracket, to be secured vertically to the side of the trusses at the top and bottom of the blocking at each Steel Framing Member (Item 3Nc) location with 16d nails or minimum 2-1/2 in. screws.

c. **Steel Framing Members*** — Used to attach furring channels (Item 3Na) to trusses. Clips spaced 48 in. OC and secured along truss webs at each furring channel intersection with min. 3/4 in. long self-drilling #10 x 2in. screws through each of the provided hole locations. Furring channels are friction fitted into clips.

PAC INTERNATIONAL L L C — Type RSIC-S1-1 Ultra

3U. **Steel Framing Members* —** (Optional, Not Shown) — For Use with Item 7G- Used as an alternate method to attach furring channels to trusses. Clips spaced 48 in. OC. and secured to the bottom chord to alternating trusses with one No. 8 x 2-1/2 in. screw and washer through the center hole. Furring channels are friction fitted into clips. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap or screw attached with two pan head screws on each leg of overlap. Additional clips required to hold furring channel that supports the gypsum board butt joints, as described in Item 4. Not evaluated for use with Item 6.

ISOTECH INDUSTRIES INC. — Type ISOWALL

4. **Gypsum Board* —** One layer of nom 5/8 in. thick, 4 ft wide gypsum board, installed with long dimension perpendicular to furring or resilient channels. Gypsum board secured with 1 in. long No. 6 Type S bugle head steel screws spaced 12 in. OC and located a min of 1-1/2 in. from side and end joints. End joints secured to both resilient channels as shown in the end joint detail. When **Steel Framing Members** (Item 3B and 3P) are used, one layer of nom 5/8 in. thick, 4 ft wide gypsum board is installed with long dimension perpendicular to furring channels. Gypsum board secured to furring channels with nom 1 in. long No. 6 Type S bugle head screws spaced 12 in. OC in the field of the board. Gypsum board butt joints shall be staggered 2 ft within the assembly, and shall occur between the main furring channels. At the gypsum board butt joints, each end of each gypsum board shall be supported by a single length of furring channel equal to the width of the gypsum board plus 6 in. on each end. The two furring channels at each butt joint shall be spaced approximately 3-1/2 in. OC, and be attached to the bottom chord of the truss with one clip at each end of the channel. Screw spacing along the gypsum board butt joint shall be 8 in. OC. When both **Steel Framing Members** (Item 3B) and **Fiber, Sprayed** (Items 6 or 6A) are used, furring channel spacing reduced to 16 in. OC and two layers of nom 5/8 in. thick, 4 ft wide gypsum board are installed with long dimension perpendicular to furring channels. Base layer secured to furring channels with nom 1 in. long No. 6 Type S bugle head screws spaced 12 in. OC in the field of the board. Gypsum board butt joints shall be staggered 2 ft within the assembly, and shall occur between the main furring channels. At the gypsum board butt joints, each end of each gypsum board shall be supported by a single length of furring channel equal to the width of the gypsum board plus 6 in. on each end. The two furring channels at each butt joint shall be spaced approximately 3-1/2 in. OC, and be attached to the bottom chord of the truss with one RSIC-1 clip at each end of the channel. Screw spacing along the gypsum board butt joint shall be 8 in. OC. Outer layer secured to furring channels using 1-5/8 in. long No. 6 Type S screws spaced 8 in. OC and 1-1/2 in. from the end joint. Butted end joints to be offset a min. of 8 in. from base layer end joints. Butted side joints of outer layer to be offset min. 18 in. from butted side joints of base layer. When **Steel Framing Members** (Item 3C) are used, two layers of nom 5/8 in. thick, 4 ft wide are installed with long dimensions perpendicular to furring channels. Base layer attached to the furring channels using 1 in. long No. 6 Type S bugle-head steel screws spaced 12 in. OC in the field of the board. Butted end joints shall be staggered min 2 ft. within the assembly, and occur midway between the continuous furring channels. Each end of each gypsum board shall be supported by a single length of furring channel equal to the width of the gypsum board plus 6 in. on each end. The two furring channels shall be spaced approximately 4 in. OC, and be attached to underside of the truss with one Isomax clip at each end of the channel. Screw spacing along the gypsum board butt joint shall be 8 in. OC. Outer layer attached to the furring channels using 1-5/8 in. long No. 6 Type S bugle-head steel screws spaced 12 in. OC in the field. The end of the outer layer boards at the butt joint shall be attached to the base layer boards with 1-5/8 in. long Type G screws spaced 8 in. OC and 1-1/2 in. from the end joint. Butted end joints to be offset a min of 8 in. from base layer end joints. Butted side joints of outer layer to be offset min 18 in. from butted side joints of base layer. When **Steel Framing Members** (Item 3D) are used, one layer of nom 5/8 in. thick, 4 ft wide gypsum board is installed with long dimensions perpendicular to furring channels. Gypsum board secured to furring channels with nom 1 in. long No. 6 Type S bugle-head steel screws spaced 12 in. OC in the field of the board. Gypsum board butted end joints shall be staggered minimum 16 in. within the assembly. . At the gypsum board butt joints, each end of each gypsum board shall be supported by a single length of furring channel equal to the width of the gypsum board plus 6 in. on each end. These additional furring channels shall be attached to underside of the truss with Genie clips as described in Item 3D. Screw spacing along the gypsum board butt joint shall be 6 in. OC. When **Steel Framing Members** (Item 3E) are used, one layer of nom 5/8 in. thick, 4 ft wide gypsum board is installed with long dimensions perpendicular to furring channels. Gypsum board secured to furring channels with nom 1 in. long Type S bugle-head steel screws spaced 8 in. OC in the field of the board. Gypsum board butted end joints shall be staggered minimum 48 in. and centered over main furring channels. At the gypsum board butt joints, each end of each gypsum board shall be supported by a single length of furring channel equal to the width of the gypsum board plus 3 in. on each end. The two support furring channels shall be spaced approximately 3 in. in from joint. Screw spacing along the gypsum board butt joint and along both additional channels shall be 8 in. OC. Additional screws shall be placed in the adjacent section of gypsum board into the aforementioned 3 in. extension of the extra butt joint channels as well as into the main channel that runs between . Butt joint furring channels shall be attached with one RESILMOUNT Sound Isolation Clip at each end of the channel. When **Fiber, Sprayed** (Items 6 or 6A) is used, two layers of nom 5/8 in. thick, 4 ft wide gypsum board are installed with long dimensions perpendicular to furring channels. Base layer gypsum board secured with 1 in. long No. 6 Type S bugle head steel screws spaced 12 in.

OC and located a min of 1-1/2 in. from side and end joints. End joints secured to both resilient channels as shown in the end joint detail. Outer layer gypsum board secured with 1-5/8 in. long No. 6 Type S bugle head steel screws spaced 12 in. OC and located a min of 1-1/2 in. from side and end joints. Outer layer shall be finished as described in Item 5. When **Foamed Plastic** insulation (Item 7E) is applied to the underside of the subflooring, screw spacing shall be reduced to 8 in. OC with minimum 1-1/4 in. long Type S screws to install gypsum to the resilient channels (Item 3A). Resilient channels (Item 3A) to be spaced maximum 12 in. OC. Butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. End joints secured to both resilient channels as shown in end joint detail.

When **Steel Framing Members** (Item 3E) are used, one layer of nom 5/8 in. thick, 4 ft wide gypsum board is installed with long dimensions perpendicular to furring channels. Gypsum board secured to furring channels with nom 1 in. long Type S bugle-head steel screws spaced 8 in. OC in the field of the board. Gypsum board butted end joints shall be staggered minimum 48 in. and centered over main furring channels. At the gypsum board butt joints, an additional single length of furring channel shall be installed and be spaced approximately 3 in. from the butt joint (6 in. from the continuous furring channels) to support the floating end of the gypsum board. Each of these shorter sections of furring channel shall extend one truss beyond the width of the gypsum panel and be attached to the adjacent trusses with one SonusClip at every truss involved with the butt joint.

When **Steel Framing Members*** (Item 3I) are used, one layer of 5/8 in. thick, 48 in. wide gypsum board, installed with long dimension perpendicular to cross channels with side joints centered along main runners. Gypsum board fastened to cross channels with 1 in. long No. 8 Type S bugle head steel screws located 1/2 in. from end joints and 1-3/4 in. from side joints and spaced 8 in. OC along the end joints and in the field. Panels fastened to cross tees with 1 in. long, Type S bugle-head screws spaced in the field and 8 in. OC along end joints. Panels fastened to main runners with 1 in. long. Type S bugle-head screws spaced midway between cross tees. Screws along sides and ends of panels spaced 3/8 to 1/2 in. from panel edge. Gypsum board sheets screw attached to leg of wall angle with 1 in. long No. 8 Type S bugle head steel screws spaced 12 in. OC. End joints of panels shall be staggered with spacing between joints on adjacent panels not less than 4 ft OC.

When **Steel Framing Members** (Item 3J) are used, one layer of nom 5/8 in. thick, 4 ft wide gypsum board is installed with long dimensions perpendicular to resilient channels. Gypsum board secured to resilient channels with nom 1 in. long Type S bugle-head steel screws spaced 8 in. OC in the field of the board and located 3/4 in. from side joints and 1-1/2 in. from end joints. Gypsum board joints are to be staggered by a minimum of 24 in.

When **Steel Framing Members** (Item 3M) are used, nom 5/8 in. thick, 4 ft wide gypsum board, installed as described in Item 4. Adjacent butt joints staggered minimum 48 in. OC.

When **Steel Framing Members** (Item 3N) are used, nom 5/8 in. thick, 4 ft wide gypsum board, installed as described in Item 4. Butt joints staggered minimum 24 in. OC.

When **Steel Framing Members** (Item 3U) are used, nom 5/8 in. thick, 4 ft wide gypsum board, installed as described in Item 4. Butt joints staggered minimum 48 in. OC.

AMERICAN GYPSUM CO — Type AG-C

CERTAINTEED GYPSUM INC — Type C

CGC INC — Types C, IP-X2, IPC-AR

CERTAINTEED GYPSUM INC — Type LGFC-C/A

GEORGIA-PACIFIC GYPSUM L L C — Types 5, DAPC, TG-C

NATIONAL GYPSUM CO — Types eXP-C, FSK-C, FSW-C, FSW-G

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type C

THAI GYPSUM PRODUCTS PCL — Type C

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR

4A. **Gypsum Board —** For use when Item 3C is used and **Batts and Blankets*** are secured to the plywood subfloor, to the trusses or draped over the furring channel/gypsum panel ceiling membrane as described in Item 3C. For method of gypsum board installation, see Item 4.
CGC INC — Types C, IP-X2, IPC-AR

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR

4B. **Gypsum Board* —** For use when **Batts and Blankets*** (Item 7A) and Resilient Channels (Item 3F) are used. Nom 5/8 in. thick, 4 ft wide gypsum board installed with long dimension perpendicular to resilient channels. Nom 1 in. long No. Type S bugle head screws are driven through channel spaced 8 in. OC. End joints of gypsum board similarly fastened to additional resilient channels positioned at end joint locations.
AMERICAN GYPSUM CO — Type AG-C.

CERTAINTEED GYPSUM INC — Type LGFC-C/A

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type C

4C. **Gypsum Board* —** For use with Items 3G and 7C or 3I and 7F, or 3I and 7C. Nom 5/8 in. thick, 48 in. wide gypsum panels installed with long dimension perpendicular to resilient channels. Gypsum panels secured with 1 in. long Type S bugle head steel screws spaced 8 in. OC and located a min of 1/2 in. from side joints and 3 in. from the end joints. Finish Rating with this ceiling system is 20 min.
CGC INC — Type ULIX

UNITED STATES GYPSUM CO — Type ULIX

4D. **Gypsum Board* —** For use when Flooring System (Item 1) consists of both System No. 1 and min 15/32 in. plywood, min grade "Underlayment" or "Sturd-I-Floor" with T & G edges and conforming with PS1-83 specifications, or min 3/4 in. thickness of any Floor Topping Mixture (CCOX) bearing the UL Classification Marking as to Fire Resistance, min Truss depth (Item 2) is 18 in. and Batts and Blankets (Item 7D) and Resilient Channels (Item 3A) are used. One layer of nom 5/8 in. thick, 48 in. wide gypsum board installed with long dimension perpendicular to resilient channels. Gypsum board secured with 1 in. long Type S bugle head steel screws. Screws spaced 1 in. from side joints, and 12 in. OC in the rest of the field. Screws spaced 1-1/2 in. from the end joints. End joints secured to both resilient channels as shown in end joint detail. When batt insulation (Item 7D) is draped over the resilient channel/gypsum board ceiling membrane, the resilient channel (Item 3A) spacing shall be reduced to 12 in. OC., and gypsum board screws spaced 1 in. from side joints, and 8 in. OC in the rest of the field. For use only with Ceiling Damper described in Item 9R.
PANEL REY S A — Type PRC2

4F. **Gypsum Board* —** For use with Items 3K, 3L, and 7G— One layer of nom 5/8 in. thick, 4 ft wide gypsum board is installed with long dimensions perpendicular to resilient channels. Gypsum board secured to resilient channels with min nom 1 in. long Type S bugle-head steel screws spaced 8 in. OC in the field of the board and located 3/4 in. from side joints and 1-1/2 in. from end joints. Gypsum board butt joints are to be staggered by a minimum of 24 in.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type C

4G. **Gypsum Board* —** For use with Items 3G and 7C. Nom 5/8 in. thick, 48 in. wide gypsum panels installed with long dimension perpendicular to resilient channels. Gypsum panels secured with 1 in. long Type S bugle head steel screws spaced 8 in. OC and located a min of 1/2 in. from side joints and 3 in. from the end joints.

AMERICAN GYPSUM CO — Type AG-C.

5. **Finishing System —** (Not Shown) — Vinyl, dry or premixed joint compound, applied in two coats to joints and screw-heads. Nom 2 in. wide paper tape embedded in first layer of compound over all joints. As an alternate, nom 3/32 in. thick veneer plaster may be applied to the entire surface of gypsum board.

6. **Fiber, Sprayed* —** (Dry Dense Packed 100% Borate Formulation) — (Not Shown, Optional) — The fiber is applied without water or adhesive at a nominal dry density of 3.5 lb/ft^3, in accordance with the application instructions supplied with the product. When Item 6 (Fiber, Sprayed, Dry Dense Packed) is used, Furring Channels (Item 3F) or Resilient Channels (Item 3A) spacing shall be reduced to 12 in. OC. When Item 6 (Fiber, Sprayed, Dry Dense Packed) is used, two layers of gypsum board required as described in Item 4. Not evaluated for use with Item 3C.
APPLEGATE GREENFIBER ACQUISITION LLC — Insulmax and SANCTUARY to be used with dry application only.

6A. **Fiber, Sprayed* —** (Loose Fill 100% Borate Formulation) — (Not Shown, Optional) — The finished rating when Fiber, Sprayed is used has not been determined. The fiber is applied without water or adhesive at a minimum dry density of 0.5 lb/ft^3 and at a max thickness of 3-1/2 in., in accordance with the application instructions supplied with the product. When Item 6A (Fiber, Sprayed, Loose Fill) is used, Furring Channels (Item 3F) or Resilient Channels (Item 3A) spacing shall be reduced to 12 in. OC. When Item 6A (Fiber Sprayed, Loose Fill) is used, two layers of gypsum board required as described in Item 4. Not evaluated for use with Item 3C.
APPLEGATE GREENFIBER ACQUISITION LLC — Insulmax & SANCTUARY to be used with dry application only.

7. **Batts and Blankets* —** (Not Shown) — For use with Item 3D — Nom 3 in. thick mineral wool insulation held suspended in the concealed space with 0.090 in. diam galv steel wires attached to the wood trusses at 18 in. OC.

7A. **Batts and Blankets* —** For Use With Items 3F and 4B — Glass fiber insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance having a min. density of 0.5 pcf, draped over the resilient channel/gypsum panel ceiling membrane. No limit on overall thickness.

7B. **Batts and Blankets* —** (Not Shown) — For use with Item 3E — Nom 3-1/2 in. thick, min. 2 pcf fiber glass insulation held suspended in the concealed space with nominal 0.090 in. diam galv steel wires attached to the wood trusses at nominally 16 in. OC.

7C. **Batts and Blankets* or Fiber, Sprayed* —** For Use with Item 4C (Not Shown) — Min. 3-1/2 in thick with no limit on maximum thickness fitted in the concealed space, draped over the resilient channel (Item 3G)/gypsum board (Item 4C or 4G) ceiling membrane.

7D. **Batts and Blankets* —** For Use With Item 4D — Insulation may be secured to plywood subfloor with staples spaced 12 in. OC or to the trusses with 0.090 in. diam galv steel wires spaced 12 in. OC. Insulation may alternatively be draped over the resilient channels and gypsum board ceiling membrane, and the resilient channels and gypsum board attachment shall be modified as specified in Item 4D. Any glass fiber insulation bearing the UL Classification Marking for Surface Burning Characteristics and/or Fire Resistance, and having a min density of 0.5 pcf and max thickness of 3-1/2 in. may be used.

7E. **Foamed Plastic* —** (As alternate to Item 6 and 6A, Not Shown) — Spray foam insulation applied directly to the underside of the plywood subflooring. Spray foam insulation installed to a maximum thickness of 10 in. at a nominal 0.5 lb/ft^3 or 2.0 lb/ft^3 density, depending on the product installed. Spray foam insulation is limited to use with minimum 18 in. deep trusses (Item 2). When spray foam insulation is installed, resilient channels (Item 3A) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board (Item 4) spaced maximum 3 in. away from gypsum butt joints. Gypsum board (Item 4) to be installed using minimum 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a ceiling damper (Item 9) in the concealed space, minimum 1 in. clearance to be maintained between damper housing and spray foam insulation. Not evaluated for use with Items 3, 3B through 3F, 3G, 6, 6A, 7 through 7D. Not evaluated with Flooring System (Item 1) Configuration No. 1.
BASF CORP — Enertite® NM, Enertite® G, FE178®, Spraytite® 178, Spraytite® 81206, Walltite® 200, Walltite® US, Walltite® US-N, Walltite® HP+, Walltite® MAX, and Walltite® v.5

7F. **Batts and Blankets* —** (Not Shown) For Use with Item 3I and 4C — Glass fiber or mineral wool insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance. There is no limit in the overall thickness of insulation, and the insulation can be secured against the subflooring, held suspended in the concealed space or draped over the Steel Framing Members and gypsum panel membrane.

7G. **Batts and Blankets* —** (Not Shown) For Use with Item 3L, 3K, 3U, and 4F — Glass fiber or mineral wool insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance. There is no limit in the overall thickness of insulation, and the insulation can be secured against the subflooring, held suspended in the concealed space or draped over the Steel Framing Members and gypsum panel membrane.

7H. **Foamed Plastic* —** (As alternate to Items 6 and 7) — Spray foam insulation applied directly to the underside of the plywood subflooring. Spray foam insulation installed to a maximum thickness of 11 in. at a nominal 1.0 lb/ft^3 - 2.5 lb/ft^3 density, while maintaining a minimum 7 in. clearance between the spray foam insulation and the gypsum board (Item 4). Spray foam insulation is limited for use with minimum 18 in. deep trusses (Item 2). When spray foam insulation is installed, resilient channels (Item 3A) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board spaced maximum 3 in. away from gypsum butt joints. Gypsum board to be installed using minimum 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a ceiling damper (Item 9) in the concealed space, no clearance is necessary between damper housing and spray foam insulation. Only for use with item 3A not evaluated for use with alternates to item 3A.
CARLISLE SPRAY FOAM INSULATION — Types SealTite Pro Closed Cell (CC), SealTite Pro Open Cell (OC), SealTite Pro OCX, SealTite Pro No Trim 21, SealTite Pro One Zero, SealTite PRO HFO, Foamsulate Closed Cell, Foamsulate OCX, Foamsulate 70, Foamsulate HFO, and Foamsulate HFO 2.0.

7I. **Batts and Blankets* —** (Not Shown - Required as indicated with Flooring System No. 26) - Glass fiber insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance. Min. 3-1/2 in. thick, 0.92 pcf density, draped over the resilient or furring channels and gypsum panel membrane. Resilient or furring channels to be spaced 12 in. OC with extra channels installed at butt joints as indicated above.

8. **Air Duct* —** (Optional) — Any UL Class 0 or Class 1 flexible air duct installed in accordance with the instructions provided by the damper manufacturer.

9. **Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max. nom area shall be 349 sq in. Max. overall length and width shall not exceed 18-11/16 in. by 18-11/16 in. with max. 16 in. by 16 in. register opening. Aggregate damper openings shall not exceed 175 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper. An aluminum or steel grille (Item 10) shall be installed in accordance with installation instructions.
MIAMI TECH INC — Model Series RxCRD, RxCRDS or RxCRPD

9A. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max damper assembly size nom 18 in. long by 18 in. wide and 4-1/4 in. high, or 8 in. diam. fabricated from galv steel. Aggregate damper openings shall not exceed 162 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper.
RUSKIN COMPANY — Model CFD7T, CFD7T-END-BT, CFD7T-90-BT, CFD7T-ST-BT, CFD7T-SB, CFD7T-R6-DB, CFD-7T-IB6 or CFDR7T

9B. Deleted.

9C. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max 12 in. diameter damper with insulated register box assembly. The maximum size of the register box assembly is nom. 20 in. long by 20 in. wide and 4 in. high fabricated from galv steel. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 128 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturers installation instructions.
AIRE TECHNOLOGIES INC — Series 57

9D. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max 20 in. long by 16 in. wide by 4 in. high rectangular damper with duct board plenum box assembly. The maximum outer dimensions of the plenum box assembly are 23-1/2 in. long by 19-1/2 in. wide and 17 in. high fabricated from 6pcf, 1-1/2 to 2 in. thick Knauf Air Duct Board M*. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 160 sq in. per 100 sq ft ceiling area. Damper assembly installed in accordance with the manufacturers installation instructions.
AIRE TECHNOLOGIES INC — Series 58

9E. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max 14 in. long by 14 in.wide by rectangular damper with 90° boot. The maximum size of damper/boot assembly is 14 in. long by 14 in. wide and 18 in. high fabricated from galv steel. The aggregate area of the register opening(s) through

the ceiling membrane shall not exceed 98 sq in. per 100 sq ft ceiling area. Damper assembly installed in accordance with the manufacturers installation instructions.
AIRE TECHNOLOGIES INC — Models 50 w/ Boot, 50EA w/ Boot, 51 w/Boot, 50 w/ Box, 50EA w/ Box or 51 w/Box

9F. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8). — For use with min 18 in. deep trusses Not for use with flooring system 1 or 17. Max plenum box size nom 19 in. long by 19 in. wide and 11-7/8 in. high fabricated from galv steel. Aggregate damper openings shall not exceed 128 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper.
LLOYD INDUSTRIES INC — Model CRD 50-BT, CRD 50-EA-BT, CRD 55-BT, CRD 55 EA-BT

UNITED ENERTECH CORP — Model C-S/R-WT-L, C-S/R-EA-L, C-S/R-BT, C-S/R-EA-BL

9G. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8). For use with min 18 in. deep trusses Not for use with flooring system 1 or 17. Max plenum box size nom 13 in. long by 13 in. wide and 11-7/8 in. high fabricated from galv steel. Aggregate damper openings shall not exceed 50 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper.
LLOYD INDUSTRIES INC — Model CRD 50-BT-6, CRD 50-EA-BT-6, CRD 55-BT-6, CRD 55 EA-BT-6

9H. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8). Ceiling damper & fan assembly for use with min 18 in. deep trusses. Not for use with flooring system 1 or 17. Max nom area shall be 103 sq in. with the length not to exceed 10-1/8 in. and the width not to exceed 10-1/8 in. Aggregate damper openings shall not exceed 52 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A plastic grille (Item 10) shall be installed in accordance with installation instructions.
PANASONIC CORPORATION, PANASONIC CORPORATION OF NORTH AMERICA — Model PC-RD05C5

9I. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8). Ceiling damper & fan assembly for use with min 18 in. deep trusses. Not for use with flooring system 1 or 17. Max nom area shall be 113 sq in. with the length not to exceed 10-1/8 in. and the width not to exceed 11-1/8 in. Aggregate damper openings shall not exceed 57 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A plastic grille (Item 10) shall be installed in accordance with installation instructions.
BROAN-NUTONE L L C — Model RDFUWT

9J. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8). Ceiling damper & fan assembly for use with min 18 in. deep trusses. Not for use with flooring system 1 or 17. Max nom area shall be 79 sq in. with the length not to exceed 10 in. and the width not to exceed 7-15/16 in. Aggregate damper openings shall not exceed 40 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A metallic grille (Item 10) shall be installed in accordance with installation instructions.
BROAN-NUTONE L L C — Models RDJ1 and RDH

9K. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8). For use with min 18 in. deep trusses. Not for use with flooring system 1 or 17. Max plenum box size nom 19 in. long by 19 in. wide and 11-7/8 in. high fabricated from galv steel. Aggregate damper openings shall not exceed 128 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper.
METAL-FAB INC — Models MSCD-HC and MRCD-HC

9L. **Alternate Ceiling Damper* —** (Optional, To be used with Air Duct Item 8). Ceiling damper & fan assembly for use with min 18 in. deep trusses. Not for use with flooring system 1 or 17. Max nom area shall be 87 sq in. with the length not to exceed 9 in. and the width not to exceed 9-11/16 in. Aggregate damper openings shall not exceed 44 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A plastic grille (Item 10) shall be installed in accordance with installation instructions.
BROAN-NUTONE L L C — Model RDMWT

9M. **Alternate Ceiling Damper* —** Ceiling damper & fan assembly for use with min 18 in. deep trusses. Max nom area shall be 87 sq in. with the length not to exceed 9 in. and the width not to exceed 9-11/16 in. Aggregate damper openings shall not exceed 44 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with,

the manufacturer's installation instructions provided with the damper. A plastic grille (Item 10) shall be installed in accordance with installation instructions.
BROAN-NUTONE L L C — Model RDMWT2

9N. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8) — For use with min 18 in. deep trusses. Not for use with flooring system 1 or 17. Max nom 21 in. long by 18 in. wide, fabricated from galvanized steel. Plenum box max size nom 21 in. long by 18 in. wide by 14 in. high (inner dimension) fabricated from either galvanized steel or min 1 in. thick Listed Duct Board bearing the UL Listing Marking having a min R-Value of 4.3. Installed in accordance with the instructions provided by the manufacturer. Max damper openings not to exceed 180 sq in. per 100 sq ft of ceiling area.
GREENHECK FAN CORP — Model CRD-1WT

9O. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8) — For use with min 18 in. deep trusses. Not for use with flooring system 1 or 17. Max nom 12 in. long by 12 in. wide with an 8 in. diameter damper, fabricated from galvanized steel. Installed in accordance with the instructions provided by the manufacturer. Max damper openings not to exceed 72 sq in. per 100 sq ft of ceiling area.
GREENHECK FAN CORP — Model CRD-2WT

9P. **Alternate Ceiling Damper* —** For use with min 18 in. deep trusses. Not for use with flooring system 1 or 17. Max nom area shall be 324 sq in. with the length not to exceed 24 in. and the width not to exceed 20 in. Max height of damper shall be 14 in. Aggregate damper openings shall not exceed 162 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper. A steel grille (Item 10) shall be installed in accordance with installation instructions.
C&S AIR PRODUCTS — Model RD-521

POTTORFF — Model CFD-521

9Q. **Alternate Ceiling Damper* —** For use with min 18 in. deep trusses. Not for use with flooring system 1 or 17. Max nom area shall be 196 sq in. with the length not to exceed 26 in. and the width not to exceed 14 in. Max height of damper shall be 7 in. Aggregate damper openings shall not exceed 98 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper. A steel grille (Item 10) not to exceed 144 $in.^2$ shall be installed in accordance with installation instructions.
C&S AIR PRODUCTS — Model RD-521-BT

POTTORFF — Model CFD-521-BT

9R. **Alternate Ceiling Damper* —** For use with min 18 in. deep trusses. Not for use with flooring system 1 or 17. Max nom area shall be 256 sq in. with the length not to exceed 24 in. and the width not to exceed 20 in. Max height of damper shall be 17 in. Aggregate damper openings shall not exceed 128 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper. A steel grille (Item 10) shall be installed in accordance with installation instructions.
C&S AIR PRODUCTS — Models RD-521-IP, RD-521-NP

POTTORFF — Models CFD-521-IP, CFD-521-NP

9S. **Alternate Ceiling Damper* —** For use with min 18 in. deep trusses. Not for use with flooring system 1 or 17. Max nom area shall be 144 sq in. with the length not to exceed 14 in. and the width not to exceed 12 in. Max height of damper shall be 17-7/8 in. Aggregate damper openings shall not exceed 74 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper. A steel grille (Item 10) shall be installed in accordance with installation instructions.
C&S AIR PRODUCTS — Models RD-521-90, RD-521-NP90

POTTORFF — Models CFD-521-90, CFD-521-90NP

9T. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min 18 in. deep trusses. For use with Item 4D only. Not for use with flooring system 1. Maximum 20 in. long by 18 in. wide by 2-1/8 in. high, fabricated from galvanized steel. Plenum box maximum size nom. 21 in. long by 18 in. wide by 16 in. high fabricated from either galvanized steel or Classified Air

Duct Materials bearing the UL Class 0 or Class 1 rigid air duct material. Installed in accordance with the instructions provided by the manufacturer. Max damper openings not to exceed 180 sq in. per 100 sq ft of ceiling area.
NAILOR INDUSTRIES INC — Types 0755, 0755A, 0756, 0756D, 0757, 0757D, 0757FP, 0757DFP, 0763

SAFE AIR DOWCO — 0455, 0455A, 0456, 0456D, 0457, 0457D, 0457-DB, 0457-CB, 0463-FB, 0457-EB, 0463-GB, 0463

9U. **Alternate Ceiling Damper* —** (Optional, to be used with Air Duct Item 8) For use with min 18 in. deep trusses. Max nom 11-1/8 in. long by 13-5/8 in. wide, fabricated from galvanized steel. Installed in accordance with the instructions provided by the manufacturer. Max damper openings not to exceed 76 sq in. per 100 sq ft of ceiling area.
GREENHECK FAN CORP — Model CRD-310WT

9V. **Alternate Ceiling Damper* —** (Optional, to be used with Air Duct Item 8) For use with min 18 in. deep trusses. Max nom 12-3/8 in. long by 14-1/2 in. wide, fabricated from galvanized steel. Installed in accordance with the instructions provided by the manufacturer. Max damper openings not to exceed 90 sq in. per 100 sq ft of ceiling area.
GREENHECK FAN CORP — Model CRD-320WT

9W. **Alternate Ceiling Damper* —** — (Optional, to be used with Air Duct Item 8) For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max 12 in. diameter damper within max 15 in. by 15 in. register box with max 12 in. by 12 in. register opening fabricated from galvanized steel. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 72 sq. in. per 100 sq. ft. of ceiling area. Damper assembly installed in accordance with the manufacturer's installation instructions.
RUSKIN COMPANY — Model CFD7T-SR

9X **Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max 12 in. diameter damper and insulated register box assembly. The maximum size of the register box assembly is nom. 20 in. long by 20 in. wide and 4 in. high fabricated from galv steel. The aggregate area of the register opening(s) through the ceiling membrane shall not exceed 128 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturers installation instructions.
SOUTHWARK METAL MFG CO — Model 800 w/Box

9Y **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max 20 in. long by 16 in. wide by 4 in. high rectangular damper with plenum box assembly. The maximum outer dimensions of the plenum box assembly are 23-1/2 in. long by 19-1/2 in. wide and 17 in. high fabricated from 6pcf, 1-1/2 to 2 in. thick Knauf Air Duct Board M*. The aggregate area of the register opening(s) through the ceiling membrane shall not exceed 160 sq in. per 100 sq ft ceiling area. Damper assembly installed in accordance with the manufacturers installation instructions.
SOUTHWARK METAL MFG CO — CRD w/DB Box

9Z **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max 14 in. long by 14 in. wide and 18 in. high ceiling damper with boot or box assembly, fabricated from galv steel. The aggregate area of the register opening(s) through the ceiling membrane shall not exceed 98 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturers installation instructions.
SOUTHWARK METAL MFG CO — Model 500 w/Boot, 510 w/Boot, 500 w/Box or 510 w/Box

9AA. **Alternate Ceiling Damper* —** (Optional, to be used with Air Duct Item 8) For use with min 18 in. deep trusses. Max nom 10-3/8 in. long by 10-3/8 in. wide, fabricated from galvanized steel. Installed in accordance with the instructions provided by the manufacturer. Max damper openings not to exceed 54 sq in. per 100 sq ft of ceiling area.

GREENHECK FAN CORP — Model CRD-300WT

9AB. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max 7-11/32 in. long by 7-11/16 in. wide fabricated from galvanized steel. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 28.5 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturer's installation instructions.

AIRE TECHNOLOGIES INC — Models ITG-CRD2.

9AC. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max 9-11/16 in long by 9-1/16 in. wide fabricated from galvanized steel. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 44.5 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturer's installation instructions.

AIRE TECHNOLOGIES INC — Models SIG-CRD2

9AD. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max 10-13/32 in. long by 10-22/32 in. wide fabricated from galvanized steel. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 56 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturer's installation instructions.

AIRE TECHNOLOGIES INC — Models SMT-CRD2

9AE. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 8.) — For use with min. 18 in. deep trusses. Not for use with flooring system 1 or 17. Max 8-13/16 in. wide and 8-1/2 in. long fabricated from galvanized steel. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 37.5 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturer's installation instructions.

AIRE TECHNOLOGIES INC — Models GBR-CRD2

10. **Grille —** Aluminum or Steel grille, installed in accordance with the installation instructions provided with the ceiling damper.

11. **Discrete Products Installed in Air-handling Spaces* —** Automatic Balancing Valve/Damper — (Not Shown - Optional) — For use with item 9A, Ruskin Company's Model CFD7T damper (CABS). Ceiling damper to be provided with plenum box per damper manufacturer's instructions with side outlet only. Entire assembly to be installed into any UL Class 0 or Class 1 flexible air duct in accordance with the instructions provided by the automatic balancing valve/damper manufacturer.
NAILOR INDUSTRIES INC — Model ABV-4, ABV-5, ABV-6

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2024-02-16

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States

Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

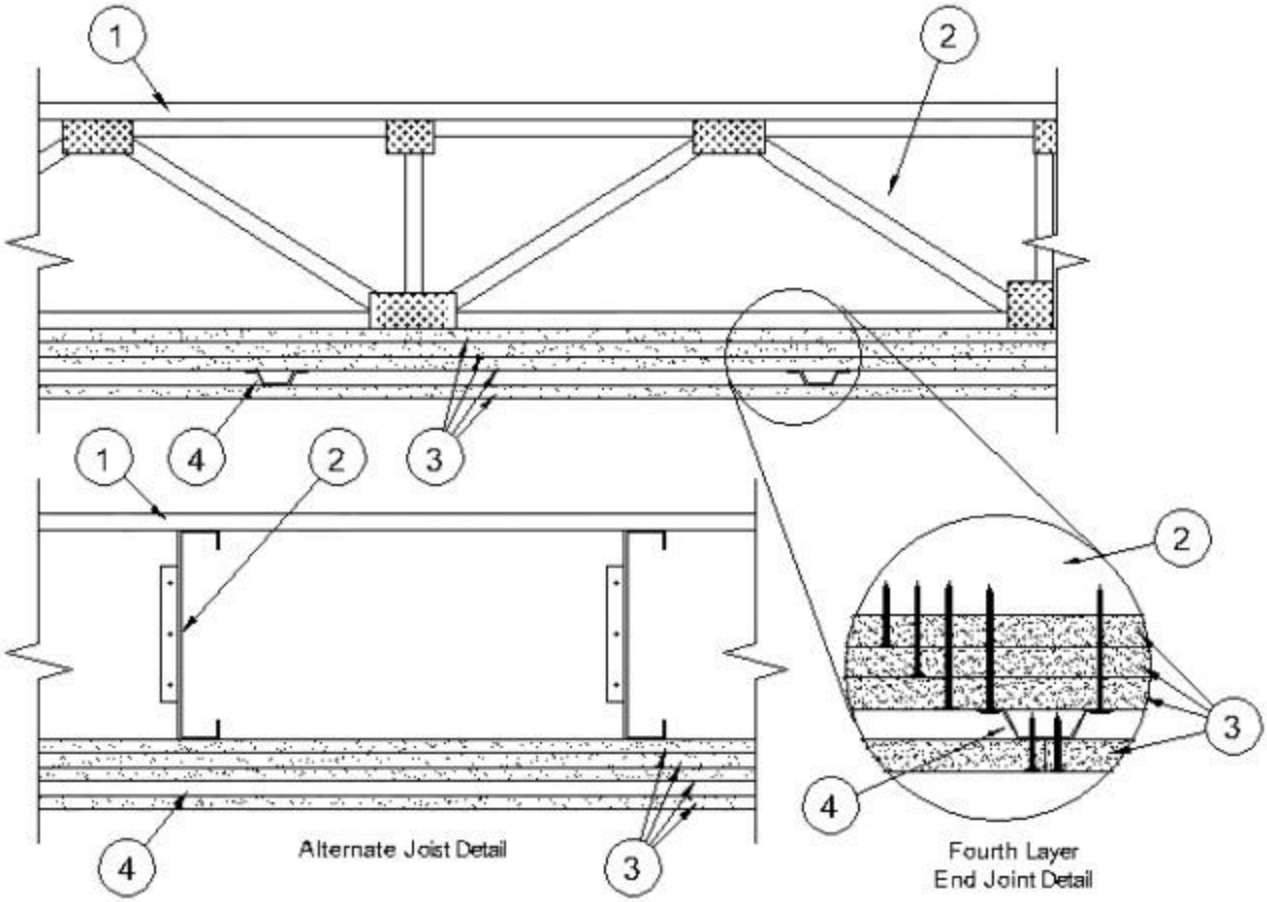
Design Criteria and Allowable Variances

Design No. **L556**

September 2, 2024

Unrestrained Assembly Rating - 2 Hr
Finish Rating - 2 Hr
This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



1. **Flooring System —** The flooring system shall consist of one of the following:

System No. 1

Subflooring — Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Finish Flooring - Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture having a minimum compressive strength of 1800 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.

UNITED STATES GYPSUM CO — Types LRK, HSLRK, CSD

USG MEXICO S A DE C V — Types LRK, HSLRK, CSD

Floor Mat Materials* — (Optional) - Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.

UNITED STATES GYPSUM CO — Types SAM, LEVELROCK® Brand Sound Reduction Board, LEVELROCK® Brand Floor Underlayment SRM-25

Alternate Floor Mat Materials* - (Optional) — Nom 3/8 in. thick floor mat material loose laid over the subfloor. Floor topping thickness shall be as specified under Floor Topping Mixture.

GRASSWORX L L C — Type SC50

System No. 2

Subflooring — Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Finish Flooring - Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture having a minimum compressive strength of 1500 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.

MAXXON CORP — Type Maxxon Standard and Maxxon High Strength

Floor Mat Materials* — (Optional) — Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.

MAXXON CORP — Type Encapsulated Sound Mat.

Floor Mat Reinforcement — (Optional) Refer to manufacturer's instructions regarding minimum thickness of floor topping for use with floor mat reinforcement.

Metal Lath — (Optional) - 3/8 in. expanded galvanized steel diamond mesh, 3.4 lbs/sq yd loose laid over the floor mat material.

Fiber Glass Reinforcement — (Optional) - 0.015 in. thick PVC coated non-woven fiberglass mesh, 0.368 lbs./sq. yd loose laid over the floor mat material.

System No. 3

Subflooring — Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Floor Mat Materials* — (Optional) — Floor mat material nom 5/64 in. (2mm) thick adhered to subfloor with Hacker Floor Primer. Primer to be applied to the surface of the mat prior to the placement of a min 1-1/4 in. of floor-topping mixture.

HACKER INDUSTRIES INC — Type Hacker Sound-Mat

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 1/4 in. (6mm) thick adhered to subfloor with Hacker Floor Primer. Primer to be applied to the surface of the mat prior to the placement of a min 1-1/4 in. (32mm) of floor-topping mixture.

HACKER INDUSTRIES INC — Type Hacker Sound-Mat II

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 1/8 in. (3mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1 in. (25mm)

HACKER INDUSTRIES INC — FIRM-FILL SCM 125

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 1/4 in. (6mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1 in. (25mm)

HACKER INDUSTRIES INC — Type FIRM-FILL SCM 250, Quiet Qurl 55/025

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 3/8 in. (10mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1-1/4 in. (32mm)

HACKER INDUSTRIES INC — FIRM-FILL SCM 400, Quiet Qurl 60/040

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 3/4 in. (19mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1-1/2 in. (38mm)

HACKER INDUSTRIES INC — Type FIRM-FILL SCM 750, Quiet Qurl 65/075

Metal Lath (Optional) — For use with 3/8 in. (10 mm) floor mat materials, 3/8 in. expanded steel diamond mesh, 3.4 lbs/sq yd placed over the floor mat material. Hacker Floor Primer to be applied prior to the placement of the metal lath. When metal lath is used, floor topping thickness a nom 1-1/4 in. over the floor mat.

Finish Flooring - Floor Topping Mixture* — Min 1 in. thickness of floor topping mixture having a min compressive strength of 1100 psi. Mixture shall consist of 6.8 gal of water to 80 lbs of floor topping mixture to 1.9 cu ft of sand.

HACKER INDUSTRIES INC — Firm-Fill Gypsum Concrete, Firm-Fill 2010, Firm-Fill 3310, Firm-Fill 4010, Firm-Fill High Strength, Gyp-Span Radiant

System No. 4

Subflooring — Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Finish Flooring - Floor Topping Mixture* — Min 1-1/2 in. thickness of floor topping mixture having a min compressive strength of 1000 psi and a cast density of 100 plus or minus 5 pcf. Foam concentrate mixed 40:1 by volume with water and expanded at 100 psi through nozzle. Mixture shall consist of 1.4 cu feet of preformed foam concentrate to 94 lbs Type I Portland cement, 300 lbs of sand with 5-1/2 gal of water.

ELASTIZELL CORP OF AMERICA — Type FF

System No. 5

Subflooring — Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Finish Flooring - Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture having a min compressive strength of 1000 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.

ARCOSA SPECIALTY MATERIALS — AccuCrete® Types NexGen, Green, Prime and PrePour, AccuRadiant®, AccuLevel® Types G40, G50 and SD30

Alternate Floor Mat Material* — (Optional) — Floor mat material nominal 2 - 9.5 mm thick loose laid over the subfloor. Floor topping shall be a min of 3/4 in.

ARCOSA SPECIALTY MATERIALS — AccuQuiet® Types D13, D-18, D25, DX38, EM.125, EM.125S, EM.250, EM.250S, EM.375, EM.375S, EM.750, and EM.750S.

System No. 6

Subflooring — Min 23/32 in. thick wood structural panels, min grade Underlayment or Single-Floor. Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Finish Flooring — Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture having a min compressive strength of 1000 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.

FORMULATED MATERIALS LLC — Types FR-25, FR-30, SiteMix, and Treadstone Advantage

Alternate Floor Mat Material* — (Optional) Floor mat material nominal 2 - 9.5 mm thick loose laid over the subfloor. Floor topping shall be a min of 3/4 in.

FORMULATED MATERIALS LLC — Types M1, M2, M3, Elite, Duo, R1, and R2

System No. 7

Subflooring — Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Finish Floor — Mineral and Fiber Board* — Min 1/2 in. thick, supplied in sizes ranging from 3 ft by 4 ft to 8 ft by 12 ft. All joints to be staggered a min of 12 in. with adjacent sub-floor joints.

HOMASOTE CO — Type 440-32 Mineral and Fiber Board

System No. 8

Subflooring — Building Units* — Nom 3/4 in. thick, tongue and grooved boards. Long dimension of boards to be perpendicular to trusses with end joints staggered a min of 4 ft. and centered over the trusses. Boards secured to trusses with 2 in. long self-drilling, self- tapping screws or 2 in. x 0.113 in. Ring Shank nails spaced a max of 12 in. OC in the field with screws/nails located 1 in. from long edge, and max 8 in. OC along the end joints with screws/nails located 1/2 in. from end joint.

ECTEK INTERNATIONAL INC — Type MegaBoard

Finish Flooring — Any finished flooring outlined in the Systems in this design.

System No. 9

Subflooring — Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Vapor Barrier — (Optional) — Commercial asphalt saturated felt, 0.030 in. thick.

Vapor Barrier — (Optional) — Nom 0.010 in. thick commercial rosin-sized building paper.

Finish Flooring* — Min 3/4 in. thickness of any Floor Topping Mixture bearing the UL Classification Marking as to Fire Resistance. See Floor- and Roof-Topping Mixtures (CCOX) category for names of Classified Companies. Refer to the manufacturer's instructions accompanying the material and/or contact the manufacturer's technical support for specific mix design and minimum thickness recommended for use with eligible floor mat(s).

Floor Mat Materials* — (Optional) — Nom. 1/4 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 3/4 in.
KEENE BUILDING PRODUCTS CO INC — Types Quiet Qurl 55/025 and Quiet Qurl 55/025 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 3/8 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 1 in.
KEENE BUILDING PRODUCTS CO INC — Types Quiet Qurl 60/040 and Quiet Qurl 60/040 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 3/4 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 1-1/2 in.
KEENE BUILDING PRODUCTS CO INC — Types Quiet Qurl 65/075, Quiet Qurl 65/075 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 1/8 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 3/4 in.
KEENE BUILDING PRODUCTS CO INC — Types Quiet Qurl 52/013 and Quiet Qurl 52/013 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 1/4 in. entangled net core with a compressible fabric attached to the bottom loose laid over the subfloor. Floor topping thickness shall be a minimum of 1 in.
KEENE BUILDING PRODUCTS CO INC — Types Quiet Qurl 55/025 MT and Quiet Qurl 55/025 N MT

System No. 10

Subflooring — Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Vapor Barrier — (Optional) — Nom 0.030 in. thick commercial asphalt saturated felt.

Finish Flooring — Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture, having a min compressive strength of 1000 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.
DEPENDABLE LLC — Types GSL M3.4, GSL K2.6, GSL-CSD and GSL RH

Floor Mat Materials* — (Optional) — Nom. 1/4 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 3/4 in.
KEENE BUILDING PRODUCTS CO INC — Types Quiet Qurl 55/025 and Quiet Qurl 55/025 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 3/8 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 1 in.
KEENE BUILDING PRODUCTS CO INC — Types Quiet Qurl 60/040 and Quiet Qurl 60/040 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 3/4 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 1-1/2 in.
KEENE BUILDING PRODUCTS CO INC — Types Quiet Qurl 65/075, Quiet Qurl 65/075 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 1/8 in. thick loose laid over the subfloor. Floor topping thickness shall be a minimum of 3/4 in.
KEENE BUILDING PRODUCTS CO INC — Types Quiet Qurl 52/013 and Quiet Qurl 52/013 N

Alternate Floor Mat Materials* — (Optional) — Floor mat material Nom. 1/4 in. entangled net core with a compressible fabric attached to the bottom loose laid over the subfloor. Floor topping thickness shall be a minimum of 1 in.
KEENE BUILDING PRODUCTS CO INC — Types Quiet Qurl 55/025 MT and Quiet Qurl 55/025 N MT

System No. 11

Subflooring — Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Finish Flooring* — Floor Topping Materials — Min 3/4 in. to 1-1/2 in. thickness of any Floor Topping Mixture bearing the UL Classification Marking as to Fire Resistance with a minimum compressive strength of 1500 psi.
See **Floor- and Roof-Topping Mixtures** (CCOX) category for names of Classified Companies. Refer to the manufacturer's instructions accompanying the material and/or contact the manufacturer's technical support for specific mix design and minimum thickness recommended for use with eligible floor mat(s).

Floor Mat Materials* — (Optional) — Floor mat material nom 1/8 in. to 3/4 in. thick. Loose laid over the subfloor. When used, Acousti-flor CSM (crack suppression mat) is loose laid over the floor mat material. Floor topping material thickness is dependent on thickness of floor mat used.
WALFLOR INDUSTRIES INC — Type Acousti-flor, Acousti-flor CSM. Floor topping thickness depends on products used as follows:

Acousti-flor (1/8 in. thick) - Floor topping thickness shall be a minimum of 3/4 in.

Acousti-flor (1/4 in. thick) - Floor topping thickness shall be a minimum of 1 in.

Acousti-flor (3/8 in. thick) - Floor topping thickness shall be a minimum of 1 in.

Acousti-flor (3/4 in. thick) - Floor topping thickness shall be a minimum of 1-1/2 in.

Metal Lath — (Optional) — Expanded steel diamond mesh, 2.5 lb / sq yd loose laid over floor mat material.

Fiberglass Mesh Reinforcement — (Optional) — Coated non-woven glass fiber mesh grid loose laid over floor mat material.

System No. 12

Subflooring — Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with

construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Finish Flooring - Floor Topping Mixture* — Min 1 in. thickness of floor topping mixture having a min compressive strength of 4500 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.
SIKA DEUTSCHLAND GMBH — Type SCHONOX AP Rapid Plus

System No. 13

Subflooring — Min 23/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to trusses with joints staggered. Plywood or panels secured to wood trusses (Item 2A) with construction adhesive and No. 6d ringed shank nails spaced 12 in. OC along each truss. Construction adhesive conforming to APA specification AFG-01 applied in 1/4 in. diam beads on top of trusses and to grooved edges of plywood or panel. Plywood or panels secured to steel joists (Item 2B) with 1-5/8 in. long No. 10 steel screws spaced 12 in. OC along each joist.

Finish Flooring - Floor Topping Mixture* — Min 3/4 in. thickness of any Floor Topping Mixture bearing the UL Classification Marking as to Fire Resistance. See Floor- and Roof-Topping Mixtures (CCOX) category for names of Classified Companies. Refer to the manufacturer's instructions accompanying the material and/or contact the manufacturer's technical support for specific mix design and minimum thickness recommended for use with eligible floor mat(s).

Floor Mat Materials* — (Optional, Not Shown) - Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.
Freudenberg Performance Materials LP — EnkaSonic® by Colbond a member of the Low & Bonar group Types 125, 250, 250 Plus, 400, 400 Plus, 750, and 750 Plus.

Floor Mat Reinforcement — (Optional) - Refer to manufacturer's instructions regarding minimum thickness of floor topping for use with floor mat reinforcement.

Metal Lath — (Optional) — Expanded steel diamond mesh, 2.5 lb / sq yd loose laid over floor mat material.

Fiberglass Mesh Reinforcement — (Optional) — Coated non-woven glass fiber mesh grid loose laid over floor mat material.

2. **Structural Wood Members —** Min 9-1/4 in. deep "I" - shaped wood joists spaced a max 24 in. OC. Min joist bearing on bearing plates 2 in. Joists secured to bearing plates with two 8d steel nails at each end. Circular holes may be cut in the web of the joists in accordance with the manufacturer's published design specifications.

2A. **Wood Joists —** As an alternate to item 2, Nominal 2 by 8 or nominal 2 by 10 in. wood joists spaced 24 in. OC, fire-stopped or min. 18 in. deep parallel chord trusses spaced a max 24 in. OC fabricated from nom 2 by 4 in. lumber with lumber oriented either vertically (2A) or horizontally (2B). Truss members secured together with No. 20 MSG galv steel truss plates. Plates have 5/16 in. long teeth projecting perpendicular to the plane of the plate. The teeth are in pairs facing each other (made by the same punch), forming a split-tooth-type plate. Each tooth has a chisel point on its outside edge. These points are diagonally opposite each other for each pair. The top half of each tooth has a twist for stiffness. The pairs are repeated on approx 7/8 in. centers with four rows of teeth per in. of plate width.

2B. **Steel Channel Joists —** As an alternate to Item 2, steel channel-shaped joists, min 8 in. deep with min 1-1/2 in. flanges and 1/4 in. stiffening flanges. The joists are fabricated from min 18 MSG galv steel. Min yield strength is 33 ksi. Joists spaced max 24 in. OC. Steel channel joists, perimeter supports, web stiffeners, bridging straps, blocking and blocking clips designed in accordance with the current edition of the Specification for the Design of Cold-Formed Steel Structural Members, published by the American Iron and Steel Institute.

3. **Gypsum Board* — Any 5/8 in. thick UL Classified Gypsum Board that is eligible for use in Design Nos. L501 or G512**. Four layers of nom 5/8 in. thick, 4 ft wide gypsum board. First three layers installed with long dimension perpendicular to bottom chord of structural members. Adjacent butt joints staggered approximately 4 ft OC. Overlapping layers installed so that edges and butt joints offset min 10 in. from previous layer. Base layer fastened to bottom chord of structural members with 1-1/4 in. long Type W or S-12 steel screws spaced 12 in. OC. Second layer secured to bottom chord of structural members with 2 in. long Type S or S-12 steel screws

spaced 12 in. OC. Third layer secured to bottom chord of structural members with 2-1/2 in Type S or S-12 steel screws spaced 12 in. OC. Fourth layer secured to resilient channels with 1-1/8 in. long Type S steel screws spaced 12 in. OC. Screws to be spaced 1/2 in. from butted end joints and 1 in. from side joints.
AMERICAN GYPSUM CO (View Classification) — CKNX.R14196

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO (View Classification) — CKNX.R19374

CABOT MANUFACTURING ULC (View Classification) — CKNX.R25370

CERTAINTEED GYPSUM INC (View Classification) — CKNX.R3660

CGC INC (View Classification) — CKNX.R19751

CERTAINTEED GYPSUM INC (View Classification) — CKNX.R18482

GEORGIA-PACIFIC GYPSUM L L C (View Classification) — CKNX.R2717

NATIONAL GYPSUM CO (View Classification) — CKNX.R3501

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM (View Classification) — CKNX.R7094

PANEL REY S A (View Classification) — CKNX.R21796

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD (View Classification) — CKNX.R19262

THAI GYPSUM PRODUCTS PCL (View Classification) — CKNX.R27517

UNITED STATES GYPSUM CO (View Classification) — CKNX.R1319

USG MEXICO S A DE C V (View Classification) — CKNX.R16089

4. **Resilient Channels —** Hat shaped channels formed from No. 25 MSG galv steel spaced 24 in. OC perpendicular to structural wood members. Channels secured to bottom chord of structural member through third layer of gypsum board with 2-1/2 in. Type S or S-12 steel screws spaced 12 in. OC.

5. **Finishing System —** (Not Shown) — Vinyl, dry or premixed joint compound, applied in two coats to joints and screw-heads. Nom 2 in. wide paper tape embedded in first layer of compound over all joints. As an alternate, nom 3/32 in. thick veneer plaster may be applied to the entire surface of gypsum board.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2024-09-02

Design/System/Construction/Assembly Usage Disclaimer

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- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
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BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States
BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

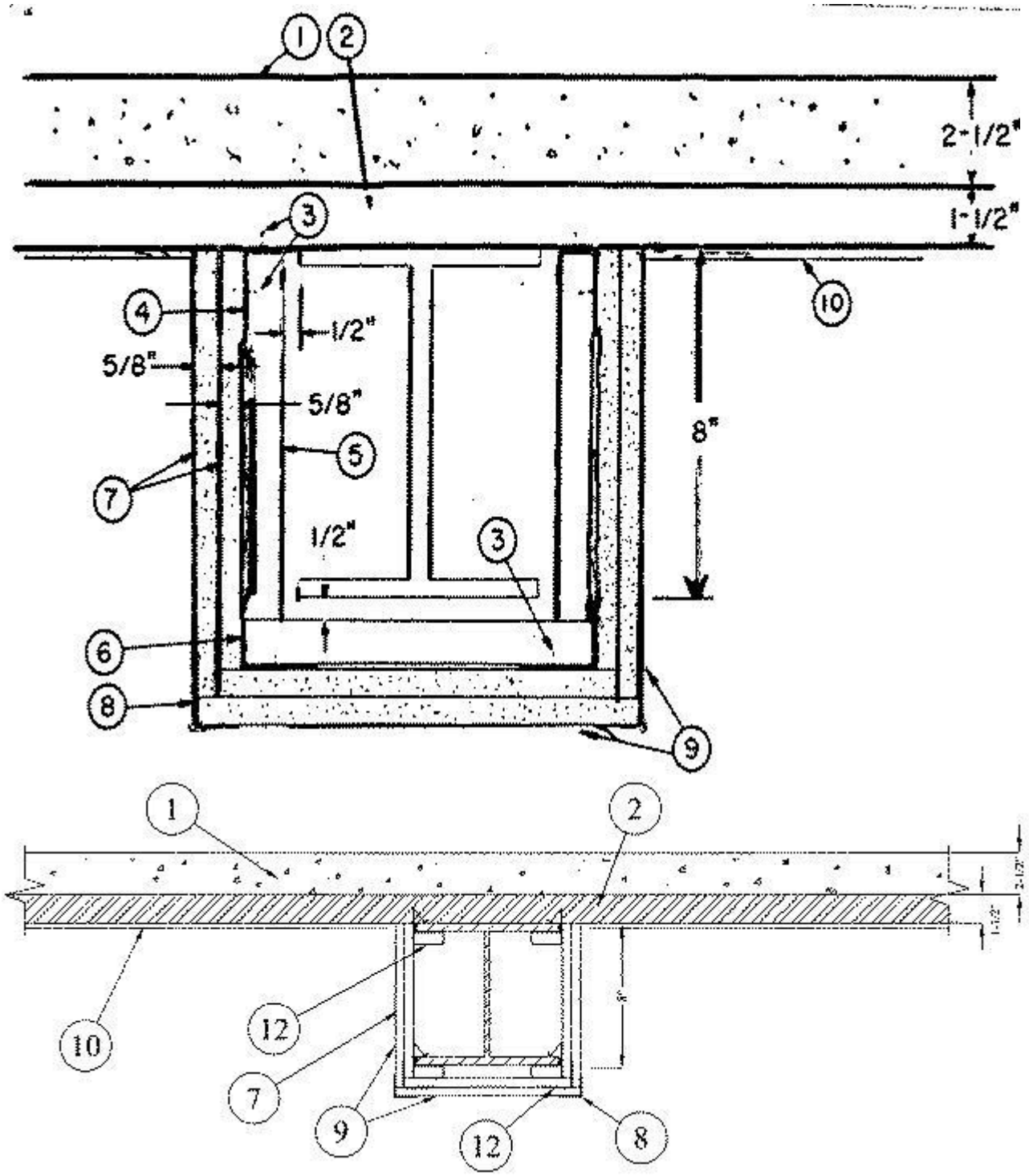
See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. **N501**

February 8, 2024

Restrained Beam Rating — 2 Hr.
Unrestrained Beam Rating — 2 Hr.
This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



Steel Beam

— Min size, a W8X24 with outside dimensions of 7-7/8x6-1/2 in. with a flange thickness of 3/8 in., a web thickness of 1/4 in., and a cross-sectional area of 7.06 sq in.

1. **Normal Weight Concrete —** 148 pcf.

2. **Steel Floor and Form Units* —** 1-1/2 in. fluted type, welded to beam.

3. **Drill Screw —** No. 8-18 by 1/2-in. long Phillips panhead drill screws, self-drilling and self-tapping, made of case-hardened steel.

4. **Runner Angle —** 24 MSG galv steel with 1 and 2-in. legs. Fastened to steel deck 12 in. O.C. with Item 3.

5. **Channel Bracket —** Fabricated from 25 MSG galv steel, 1-11/16 in. deep with 1-in. legs and spaced 24 in. O.C. Fastened to the runner angles with Item 3.

6. **Corner Angle —** Same material as Item 4, fastened to channel brackets with Item 3.

7. **Gypsum Board* —** 5/8 in. thick. First layer fastened with 1-1/4 in. long, 0.150 in. diam screws spaced 16 in. O.C. Second layer attached with 1-3/4 in. long, 0.150 in. diam screws spaced 8 in. O.C. Screws are self-drilling and self-tapping Phillips head made of case-hardened steel.
AMERICAN GYPSUM CO — Types AGX-1, AG-C, LightRoc.

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO — Type DBX-1.

CABOT MANUFACTURING ULC — Type X, 5/8 Type X, Type Blueglass Exterior Sheathing

CERTAINTEED GYPSUM INC — Types EGRG, GlasRoc, GlasRoc-2, Type C, Type X-1, Easi-Lite Type X-2, LWTX.

CGC INC — Type C, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRX, ULIX.

CERTAINTEED GYPSUM INC — Types LGFC6A, LGFC-C/A.

GEORGIA-PACIFIC GYPSUM L L C — Types 5, C, DAP, DD, DA, DAPC, DGG, DS, GPFS1, GPFS6, TG-C, Type X, Veneer Plaster Base-Type X, Water Rated-Type X, Sheathing Type-X, Soffit-Type X, GreenGlass Type X, Type LWX, Veneer Plaster Base-Type LWX, Water Rated-Type LWX, Sheathing Type-LWX, Soffit-Type LWX, Type LW2X, Veneer Plaster Base - Type LW2X, Water Rated - Type LW2X, Sheathing - Type LW2X, Soffit - Type LW2X.

NATIONAL GYPSUM CO — Types FSK, FSK-C, FSK-G, FSL, FSMR-C, FSW, FSW-C, FSW-G, FSW-3, FSW-6, FSW-8.

NATIONAL GYPSUM CO — Riyadh, Saudi Arabia — Type FR, or WR.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Types C, PG-3, PG-9, PG-11, PG-C, PGS-WRS or PGI.

PANEL REY S A — Type PRC

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD — Type EX-1

THAI GYPSUM PRODUCTS PCL — Type C, Type X.

THE SIAM GYPSUM INDUSTRY (SONGKHLA) CO — Types C and SCX

UNITED STATES GYPSUM CO — Types C, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRX, ULIX.

USG BORAL DRYWALL SFZ LLC — Types C, SCX

USG MEXICO S A DE C V — Types C, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRX.

8. **Corner Bead —** Fabricated from 20 MSG galv steel to form an angle with 1-1/4 in. legs. Legs perforated with 1/4 in. diam holes approx 1 in. OC. Attached to wallboard with special crimping tool approx 6 in. OC. As an alternate, the bead may be nailed to the wallboard.

9. **Joint Compound —** 1/32 in. thick on bottom and sides of wallboard from corner beads and feathered out. Paper tape embedded in joint compound over joints with edges of compound feathered out.

10. **Protective Material — Spray-Applied Fire Resistive Materials* —** Spray applied to the underside of the steel floor units, filling the flutes of the units and providing a smooth ceiling which was 1/4 in. thick as measured from the bottom plane of the floor units.
See Spray-Applied Fire Resistive Materials (CHPX) category for names of manufacturers.

11. **Alternate Joint System —** (Not Shown) — For lath only. A 1/16 in. thickness of gypsum plaster applied to entire exposed surface over either paper tape on joints embedded in cementitious compound or 2 1/2 in. wide glass fiber tape stapled 8 in. OC on joints.

12. **Alternate Construction - Steel Framing Members* —** As an alternate to Items 3, 4, 5 and 6 steel clips attached to both sides of beam flanges 2 ft OC and at ends of beam. First layer of gypsum board fastened to steel clips with 1-1/4 in. long Type S drywall screws. 2 in. by 2 in. 25 MSG angle fastened to clips on bottom portion of assembly with 2 in. long Type S drywall screws. Second layer of gypsum board fastened to angle and steel clips with 2 in. long Type S drywall screws, spaced 2 ft OC. Screws are self-drilling and self-tapping Phillips head made of case-hardened steel.
JOHN WAGNER ASSOCIATES INC, DBA GRABBER — Type CB Clip.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2024-02-08

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BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. N743

October 08, 2019

Restrained Beam Ratings — 1, 1-1/2, 2, 3 and 4 Hr

Unrestrained Beam Ratings — 1, 1-1/2, 2, 3 and 4 Hr

Loading Determined by Allowable Stress Design Method or Load and Resistance Factor Design Method published by the American Institute of Steel Construction, or in accordance with the relevant Limit State Design provisions of Part 4 of the National Building Code of Canada

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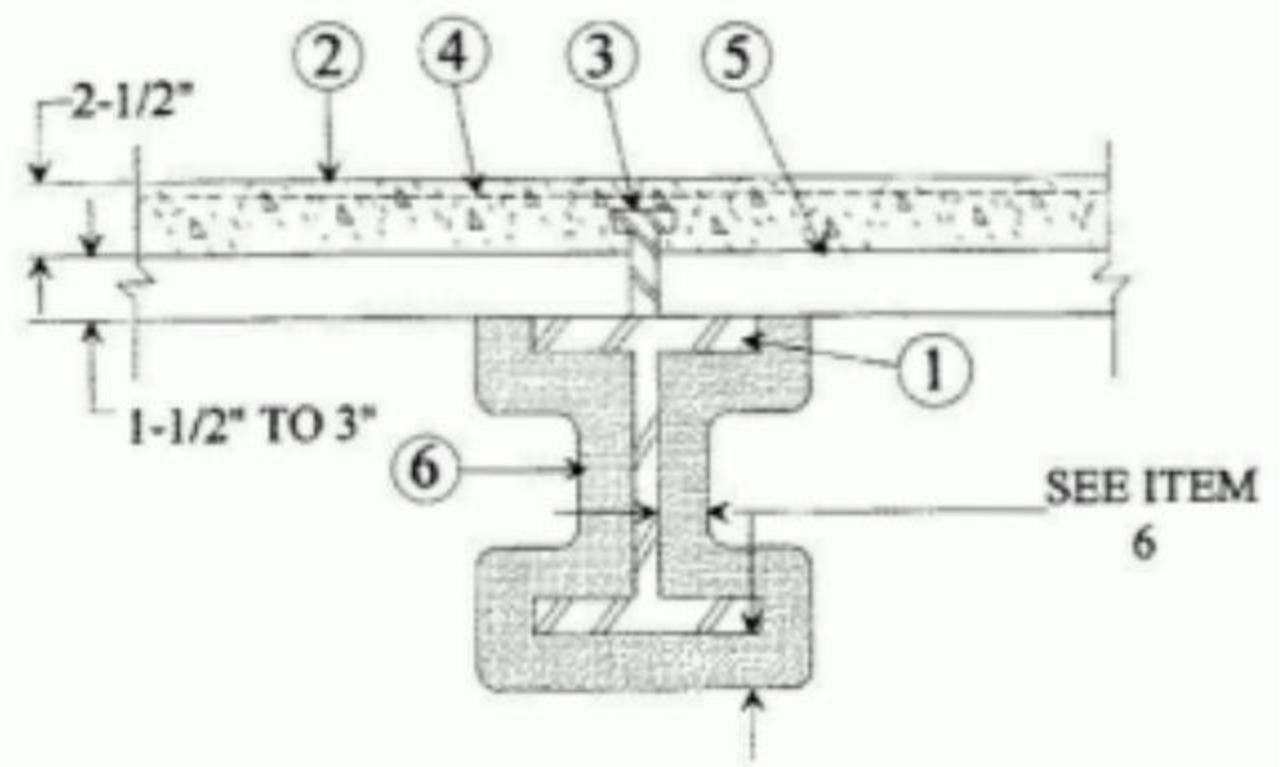

1. **Steel Beam —** W8x28 min size.

2. **Normal Weight or Lightweight Concrete —** Normal weight concrete: carbonate or siliceous aggregate, 3500 psi compressive strength, unit weight 145 ± 3 pcf. Lightweight concrete: expanded shale, clay, or slate aggregate by rotary-kiln method, 3500 psi compressive strength, unit weight 110 ± 3 pcf.

3. **Shear Connector —** (Optional) — Studs, 3/4 in. diam headed type or equivalent per AISC specifications. Welded to the top flange of beam through the steel floor units.

4. **Welded Wire Fabric —** (Optional) — 6x6-10/10 SWG.

5. **Steel Floor and Form Units* —** 1-1/2 to 3 in. deep fluted, cellular or corrugated units in any combination welded to beam.

6. **Spray-Applied Fire Resistive Materials* —** Prepared by mixing with water. Spray-applied in one or more coats to beam surfaces to a min final thickness as shown in the tables below. Beam surfaces must be clean and free of dirt, loose scale and oil. Crest areas of deck above the beams shall be filled with Spray-Applied Fire Resistive Materials. Min average and min individual density of 15 pcf and 14 pcf respectively for Types 300, 300AC, 300ES, 300HS, 300N, 3000, 3000ES and SB. For Types 400, 400AC and 400ES min average and min individual density of 22 pcf and 19 pcf respectively. Min avg density of 44 pcf with min ind value of 40 pcf for Types M-II and TG. Min avg density of 47 pcf, with min individual value of 43 pcf for Type M-II/P. For method of density determination, see Design Information Section, Sprayed Material.
The thicknesses of Spray-Applied Fire Resistive Materials shown in the table below are applicable when the beams are supporting solid concrete slabs or floor assemblies containing only fluted floor or form units with normal weight concrete.

	Min Thkns In.	
Rating Hr	**Restrained Beam**	**Unrestrained Beam**
1	3/8	3/8
1-1/2	7/16	9/16
2	11/16	3/4
3	1-1/16	1-3/16

4	1-7/16	1-5/8

The thicknesses of Spray-Applied Fire Resistive Materials shown in the table below are applicable when the beams are supporting solid concrete slabs or floor assemblies containing only fluted floor or form units with lightweight concrete.

	Min Thkns In.	
Rating Hr	**Restrained Beam**	**Unrestrained Beam**
1	1/2	1/2
1-1/2	5/8	3/4
2	7/8	1
3	1-3/8	1-5/8
4	1-7/8	2-1/4

The thicknesses of Spray-Applied Fire Resistive Materials shown in the table below are applicable when the beams are supporting floor assemblies containing cellular or corrugated floor units with normal weight concrete.

	Min Thkns In.	
Rating Hr	**Restrained Beam**	**Unrestrained Beam**
1	1/2	1/2
1-1/2	9/16	11/16
2	7/8	15/16
3	1-3/8	1-9/16
4	1-7/8	2-1/8

The thicknesses of Spray-Applied Fire Resistive Materials shown in the table below are applicable when the beams are supporting floor assemblies containing cellular or corrugated floor units with lightweight concrete.

	Min Thkns In.	
Rating Hr	**Restrained Beam**	**Unrestrained Beam**
1	5/8	5/8
1-1/2	13/16	15/16
2	1-1/8	1-1/4
3	1-13/16	2-1/8
4	2-7/16	2-15/16

BERLIN CO LTD — Types 400, 300, 300ES, 300N, or SB; Types M-II, TG and M-II/P

GREENTECH ASIA PACIFIC SDN BDH — Types 300, 300ES, 300HS, 400, M-II, or M-II/P

GREENTECH THERMAL INSULATION PRODUCTS MFG CO L L C — Types 300, 300AC, 400, or 400AC; Types M-II, TG and M-II/P

ISOLATEK INTERNATIONAL — Types 300, 300AC, 300ES, 300HS, 300N, SB, 400, 400AC, 400ES, 3000, or 3000ES; Types M-II, TG and M-II/P

NEWKEM PRODUCTS CORP — Types 300, 300ES, 300N, 400, or SB; Types M-II, TG and M-II/P

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Last Updated on 2019-10-08

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BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States
BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. P556

February 16, 2024

Unrestrained Assembly Rating — 1 Hr.
Finish Rating — 24 or 25 Min (See Items 3, 3A and 3B)
This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

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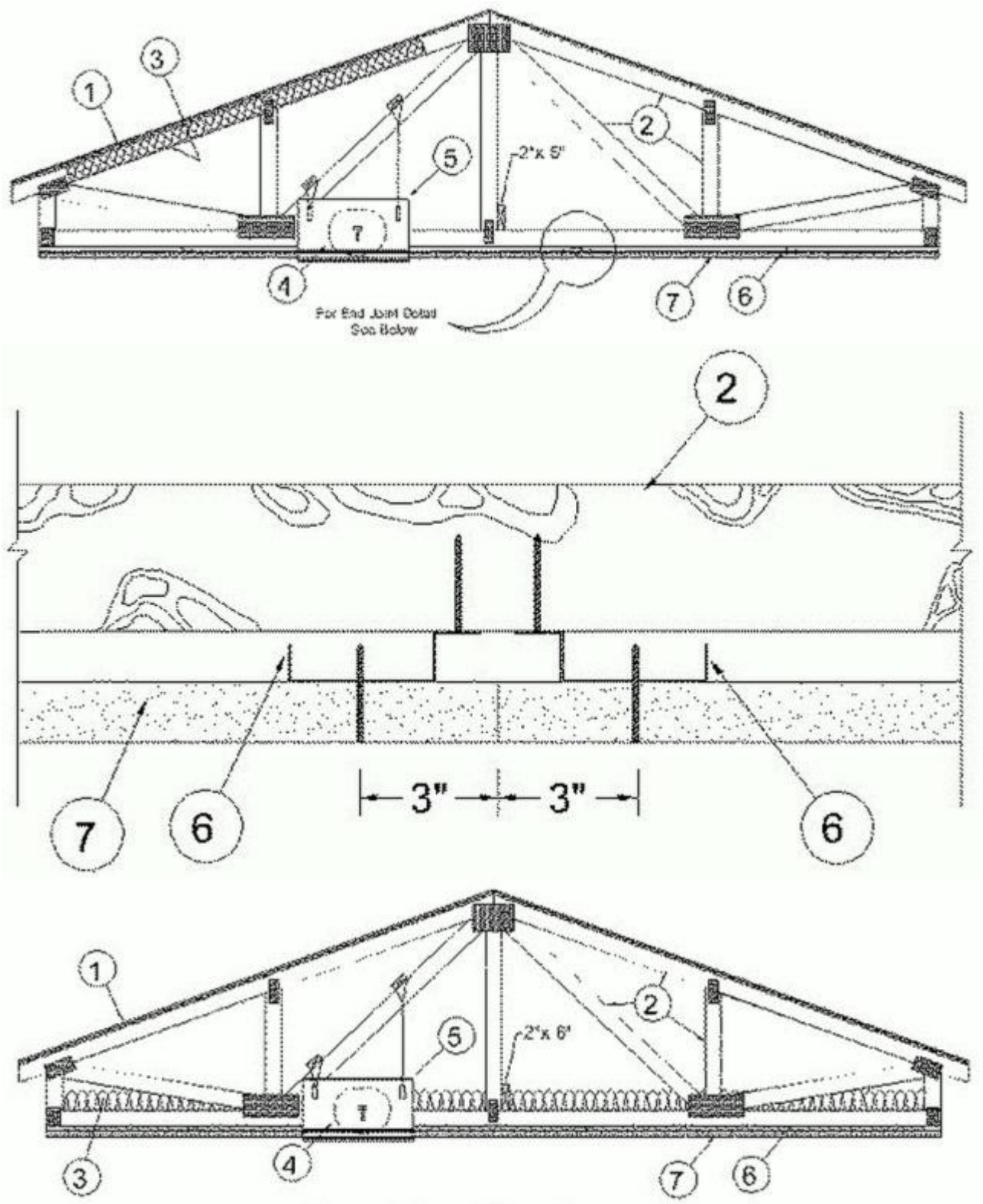


Alternate Insulation Placement

1. **Roofing System* —** Any UL Class A, B or C Roofing System **(TGFU)** or Prepared Roof Covering **(TFWZ)** acceptable for use over nom 15/32 in. thick wood structural panels, min. grade "C-D" or "Sheathing". Nom 15/32 in. thick wood structural panels secured to trusses with No. 6d ringed shank nails. Nails spaced 12 in. OC along each truss. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails. Construction adhesive is optional and may be used with either nails or staples.

2. **Trusses —** Pitch or Parallel chord trusses, spaced a max of 24 in. OC, fabricated from nom 2 by 4 lumber, with lumber oriented vertically or horizontally. Truss members secured together min.0.0356 in. thick galv steel plates. Plates have 5/16 in. long teeth projecting perpendicular to the plane of the plate. The teeth are in pairs facing each other (made by the same punch), forming a split tooth type plate. Each tooth has a chisel point on its outside edge. These points are diagonally opposite each other for each pair. The

top half of each tooth has a twist for stiffness. The pairs are repeated on approximately 7/8 in. centers with four rows of teeth per inch of plate width. Minimum parallel chord truss depth shall be 18 in. Where the truss intersects with the interior face of the exterior walls, the min truss depth shall be 5-1/4 in. with a min roof slope of 3/12 and a min. average depth of 18 in.. Where the truss intersects with the interior face of the exterior walls, the min truss depth may be reduced to 3 in. if the batts and blankets (Item 3) are used as shown in the above illustration (Alternate Insulation Placement) and are firmly packed against the intersection of the bottom chords and the plywood sheathing.

3. **Batts and Blankets* —** (Optional) -Glass fiber insulation, secured to the wood structural panesl with staples spaced 12 in. OC or to the trusses with 0.090 in. diam galv steel wires spaced 12 in. OC. Any glass fiber insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance, having a min density of 0.5 pcf. As an option, the insulation may be fitted in the concealed space, draped over the resilient channel/gypsum board ceiling membrane when resilient channels and gypsum board attachment is modified as specified in Items 6 and 7. The Finish Rating is 24 min. when the insulation is draped over the resilient channels and gypsum board ceiling membrane and 25 min. when it is installed on underside of the plywood deck or when it is omitted.

3A. **Loose Fill Material* —** As an alternate to Item 3 — Any thickness of loose fill material bearing the UL Classification Marking for Surface Burning Characteristics, having a min density of 0.5 pcf, fitted in the concealed space, draped over the resilient channel/gypsum board ceiling membrane when resilient channels and gypsum board attachment is modified as specified in Items 6 and 7. The finished rating when loose fill material is used has not been determined.

3B. **Fiber, Sprayed* —** As an alternate to Items 3 and 3A (not evaluated for use with Items 6B, 6C, 6D and 6E) — Any thickness of spray-applied cellulose insulation material, having a min density of 0.5 lb/ft3, applied with water, over the resilient channel/gypsum board ceiling membrane when resilient channels and gypsum board attachment is modified as specified in Items 6 and 7. Fiber, Sprayed is applied with moisture in accordance with the application instructions supplied with the product. The finish rating when Fiber Sprayed is used has not been determined. Alternate application method: The fiber is applied without water or adhesive in accordance with the application instructions supplied with a minimum density of 0.5 lb/ft3 over the resilient channel/gypsum board ceiling membrane when resilient channels and gypsum board attachment is modified as specified in Items 6 and 7. Alternate application method: The fiber is applied without water or adhesive to a nominal density of 3.5 lb/ft3 behind netting (Item 9) stapled to the rafters. The netting is stapled at both lower edges of the rafters creating a cavity to accept the cellulose fiber.
APPLEGATE GREENFIBER ACQUISITION LLC — Insulmax and SANCTUARY for use with wet or dry application.

3C. **Foamed Plastic* —** (As an alternate to Item 3 - Not Shown) — Spray foam insulation applied directly to the underside of the underside of the roofing system (Item 1). Spray foam insulation installed to a maximum thickness of 10 in. at a nominal 0.5 lb/ft^3 density, while maintaining a minimum 8-1/2 in. clearance between the spray foam insulation and the gypsum board (Item 7). When spray foam insulation is used, resilient channels (Item 6) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board (Item 7) installed at 6 in. OC to allow for maximum 3 in. spacing off ends of the gypsum board joints. Gypsum board (Item 7) to be installed using 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a ceiling radiation damper in the concealed space, minimum 1 in. clearance to be maintained between damper housing and spray foam insulation. . Limited to resilient channels, Item 6 only, no Item 6 alternates. The finished rating when this insulation is used has not been determined.
SES FOAM INC — Sucraseal

3D. **Foamed Plastic* —** (As alternate to Item 3 - Not Shown) — Spray foam insulation applied directly to the underside of the roofing system (Item 1). Spray foam insulation installed to a maximum thickness of 10 in. at a nominal 0.5 lb/ft^3 or 2.0 lb/ft^3 density, depending on the product installed. When spray foam insulation is installed, resilient channels (Item 6) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board (Item 7) spaced maximum 3 in. away from gypsum butt joints. Gypsum board (Item 7) to be installed using minimum 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a ceiling radiation damper in the concealed space, minimum 1 in. clearance to be maintained between damper housing and spray foam insulation. Limited to resilient channels, Item 6 only, no Item 6 alternates. The finished rating when this insulation is used has not been determined.
BASF CORP — Enertite® NM, Enertite® G, FE178®, Spraytite® 178, Spraytite® 81206, Walltite® 200, Walltite® US, Walltite® US-N, Walltite® HP+, Walltite® MAX, and Walltite® v.5

3E. **Foamed Plastic* —** (As an alternate to Item 3 - Not Shown) — Spray foam insulation applied directly to the underside of the underside of the roofing system (Item 1). Spray foam insulation installed to a maximum thickness of 17 in. at a nominal 0.5 lb/ft^3 density, while maintaining a minimum 1-1/2 in. clearance between the spray foam insulation and the gypsum board (Item 7). When spray foam insulation is used, resilient channels (Item 6) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board (Item 7) installed at 6 in. OC to allow for maximum 3 in. spacing off ends of the gypsum board joints. Gypsum board (Item 7) to be installed using 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a fire damper (Items 5 through 5B) in the concealed space, no clearance is necessary between damper housing and spray foam insulation. . Limited to resilient channels, Item 6 only, no Item 6 alternates. The finished rating when this insulation is used has not been determined.
SES FOAM INC — EasySeal.5, EasySeal ULD

3F. **Foamed Plastic* —** (As an alternate to Item 3 - Not Shown) — Spray foam insulation applied directly to the underside of the underside of the roofing system (Item 1). Spray foam insulation installed to a maximum thickness of 17 in. at a nominal 0.5 lb/ft^3 density, while maintaining a minimum 1-1/2 in. clearance between the spray foam insulation and the gypsum board (Item 7). When spray foam insulation is used, resilient channels (Item 6) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board (Item 7) installed at 6 in. OC to allow for maximum 3 in. spacing off ends of the gypsum board joints. Gypsum board (Item 7) to be installed using 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a fire damper (Items 5 through 5B) in the concealed space, no clearance is necessary between damper housing and spray foam insulation. . Limited to resilient channels, Item 6 only, no Item 6 alternates. The finished rating when this insulation is used has not been determined.

EVEREST SYSTEMS LLC — Opticell 0.5

4. **Air Duct* —** For use with **Ceiling Dampers*** - Any UL Class 0 or Class 1 flexible air duct installed in accordance with the instructions provided by the damper manufacturer.

5. **Ceiling Damper* —** Max 14 in. long by 14 in. wide by 18 in. high ceiling damper with boot or box assembly, fabricated from galv steel. The aggregate area of the register opening(s) through the ceiling membrane shall not exceed 98 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturers installation instructions.
AIRE TECHNOLOGIES INC — Model 50 w/Boot, 50EA w/Boot, 51 w/Boot, 50 w/Box, 50EA w/Box or 51 w/Box.

AIRVAC INDUSTRIES — Series AVI-50 w/Boot, AVI-50EA w/Boot, AVI-51 w/Boot, AVI-50 w/Box, AVI-50EA w/Box, AVI-51 w/Box.

5A. **Alternate Ceiling Damper* —** Max 12 in. diameter damper and insulated register box assembly. The maximum size of the register box assembly is nom. 20 in. long by 20 in. wide and 4 in. high fabricated from galv. Steel. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 128 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturers installation instructions.
AIRE TECHNOLOGIES INC — Series 57

AIRVAC INDUSTRIES — Model AVI-57IB

5B. **Alternate Ceiling Damper* —** Max 20 in. long by 16 in. wide by 4 in. high rectangular damper with duct board plenum box assembly. The maximum outer dimensions of the plenum box assembly is 23-1/2 in. long by 19-1/2 in. wide and 17 in. high fabricated from 6pcf, 1-1/2 to 2 in. thick Knauf Air Duct Board M*. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 160 sq in. per 100 sq ft ceiling area. Damper assembly installed in accordance with the manufacturers installation instructions.
AIRE TECHNOLOGIES INC — Series 58

AIRVAC INDUSTRIES — Series AVI-58

5C. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 4.) — For use with min. 18 in. deep trusses. Max 7-11/32 in. long by 7-11/16 in. wide fabricated from galvanized steel. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 28.5 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturer's installation instructions.

AIRE TECHNOLOGIES INC — Models ITG-CRD2.

5D. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 4.) — For use with min. 18 in. deep trusses. Max 9-11/16 in long by 9-1/16 in. wide fabricated from galvanized steel. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 44.5 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturer's installation instructions.

AIRE TECHNOLOGIES INC — Models SIG-CRD2

5E. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 4.) — For use with min. 18 in. deep trusses. Max 10-13/32 in. long by 10-22/32 in. wide fabricated from galvanized steel. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 56 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturer's installation instructions.

AIRE TECHNOLOGIES INC — Models SMT-CRD2

5F. **Alternate Ceiling Damper* —** (Optional. To be used with Air Duct Item 4.) — For use with min. 18 in. deep trusses. Max 8-13/16 in. wide and 8-1/2 in. long fabricated from galvanized steel. Aggregate area of the register opening(s) through the ceiling membrane shall not exceed 37.5 sq in. per 100 sq ft of ceiling area. Damper assembly installed in accordance with the manufacturer's installation instructions.

AIRE TECHNOLOGIES INC — Models GBR-CRD2

6. **Furring Channels —** Resilient channels formed of 25 MSG galv steel, spaced 16 in. OC, installed perpendicular to trusses. When batt and blanket material, Item 3, is draped over the resilient channel/gypsum board ceiling membrane, the spacing shall be 12 in. OC. Channels secured to each truss with 1-1/4 in. long Type S steel screws. Channels overlapped 4 in. at splices. Channels oriented opposite at board butt joints (spaced 6 in. OC) as shown in the above illustration.

6A. **Steel Framing Members* - (Not Shown) —** As an alternate to Item 6, furring channels and Steel Framing Members* as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel, 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced 16 in. OC perpendicular to trusses. When batt insulation (Item 3) is draped over the resilient channel/gypsum board ceiling membrane, the resilient channel spacing shall be reduced to 12 in. OC. Channels secured to trusses as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to trusses (Item 2). Clips spaced 48 in. OC. RSIC-1 and RSIC-1 (2.75) clips secured to alternating trusses with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. RSIC-V and RSIC-V (2.75) clips secured to alternating trusses with No. 8 x 1-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips. RSIC-1 and RSIC-V clips for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) and RSIC-V (2.75) clips for use with 2-23/32 in. wide furring channels. Adjoining channels are overlapped as described in Item a. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping No. 6 framing screws, min 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Additional clips required to hold furring channel that supports the gypsum board butt joints, as described in Item 7.
PAC INTERNATIONAL L L C — Types RSIC-1, RSIC-V, RSIC-1 (2.75), RSIC-V (2.75).

6B. **Steel Framing Members* —** (Not Shown) - As an alternate to Items 6 and 6A.
a. **Furring Channels —** Hat-shaped furring channels, 7/8 in. deep by 2-5/8 in. wide at the base and 1-1/4 in. wide at the face, formed from No. 25 ga. galv steel, spaced max 16 in. OC perpendicular to trusses and Cold Rolled Channels (Item 6Bb). Furring channels secured to Cold Rolled Channels at every intersection with a 1/2 in. pan head self-drilling screw through each furring channel leg. Ends of adjoining channels overlapped 4 in. and tied together with two double strand No. 18 SWG galv steel wire ties, one at each end of overlap. Supplemental furring channels at base layer and outer layer gypsum board butt joints are not required. Batts and Blankets draped over furring channels as described in Item 3. Two layers of gypsum board attached to furring channels as described in Item 7.

b. **Cold Rolled Channels —** 1-1/2 in. by 1/2 in., formed from No. 16 ga. galv steel, positioned vertically and parallel to trusses, friction-fitted into the channel caddy on the Steel Framing Members (Item 6Bd). Adjoining lengths of cold rolled channels lapped min. 6 in. and wire-tied together with two double strand 18 SWG galv steel wire ties, one at each end of overlap.

c. **Blocking —** Where truss design does not permit direct, full contact of the hanger bracket, a piece of nominal 2 by 4 in. lumber (blocking), min. 6 in. long to permit full contact of the hanger bracket, to be secured vertically to the side of the truss (Item 2) at the top and bottom of the blocking at each Steel Framing Member (Item 6Bd) location.

d. **Steel Framing Members* —** Hangers spaced 48 in. OC. max along truss, and secured to the Blocking (Item 6Bc) on alternating trusses with a single 5/16 in. by 2 in. hex head lag bolt or four #6 1-1/4 in. drywall screws through mounting hole(s) on the hanger bracket. The two 1/4 in. long steel teeth on the hanger are embedded in the side of the blocking. Hanger positioned on blocking and leveling bolt height adjusted such that furring channels are flush with bottom of trusses before gypsum board installation. Spring gauge of hanger chosen per manufacturer's instructions.
KINETICS NOISE CONTROL INC — Type ICW.

6C. **Steel Framing Members* —** (Not Shown) - As an alternate to Items 6, 6A and 6B.
a. **Furring Channels —** Formed of No. 25 MSG galv steel, 2-3/8 in. wide by 7/8 in. deep installed perpendicular to wood structural members. Channels spaced a max of 16 in. OC when no insulation (Item 3, 3A or 3B) is fitted in the concealed space or a max of 12 in. OC when insulation (Item 3, 3A or 3B) is fitted in the concealed space. Channels secured to trusses as described in Item 6Cb. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire near each end of overlap.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Ca) to trusses (Item 2). Clips secured to the bottom chord of each truss (24 in. OC) with one No. 8 by 2-1/2 in. long coarse drywall screw through center grommet. Furring channels are friction fitted into clips. Adjoining channels are overlapped as described in Item 6Ca. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping No. 6 framing screws, min 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Additional clips required to hold furring channel that supports the gypsum board butt joints, as described in Item 7.
PLITEQ INC — Type Genie Clip

6D. **Steel Framing Members* —** (Not Shown) - As an alternate to Items 6, 6A, 6B and 6C.
a. **Main runners —** Installed perpendicular to trusses — Nom 10 or 12 ft long, 15/16 in. or 1-1/2 in. wide face, spaced 4 ft OC. Main runners hung a min of 2 in. from bottom chord of trusses with 12 SWG galv steel wire. Wires located a max of 48 in. OC.

b. **Cross tees or channels —** Nom 4 ft long, 15/16 in. or 1-1/2 in. wide face or cross channels, nom 4 ft long, 1-1/2 wide face, installed perpendicular to the main runners, spaced 16 in. OC. Additional cross tees or channels used at 8 in. from each side of butted gypsum board end joints. The cross tees or channels may be riveted or screw-attached to the wall angle or channel to facilitate the ceiling installation.

c. **Wall angles or channels —** Used to support steel framing member ends and for screw-attachment of the gypsum board — Min 0.016 in. thick painted or galvanized steel angle with 1 in. legs or min. 0.016 in. thick painted or galvanized steel channel with a 1 by 1-1/2 by 1 in. profile, attached to walls at perimeter of ceiling with fasteners 16 in. OC.
CGC INC — Type DGL or RX.

USG INTERIORS LLC — Type DGL or RX.

6E. **Alternate Steel Framing Members* —** (Not Shown) - As an alternate to items 6, 6A, 6B, 6C and 6D, furring channels and Steel Framing Members as described below.
a. **Furring Channels —** Formed of No. 25 MSG galv steel, 2-5/8 in. wide by 7/8 in deep, spaced 16 in OC, perpendicular to trusses. When batt insulation (Item 3, 3A or 3B) is draped over the resilient channel/gypsum board ceiling membrane, the resilient channel spacing shall be reduced to 12 in. OC. Channels secured to trusses as described in Item b.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to the wood trusses (Item 2). Clips spaced at 48" OC and secured to the bottom of the trusses with one 2 in. Coarse Drywall Screw with 1 in. diam washer through the center hole. Furring channels are then friction fitted into clips. Ends of channels are overlapped 6" and tied together with double strand of No. 18 AWG galvanized steel wire.Additional clips are required to hold the Gypsum Butt joints as described in Item 7.
STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237 or A237R

6F. **Steel Framing Members* —** (Not Shown) - As an alternate to Items 6 through 6E- Not for use with Items 3, 3A, or 3B. Main runners nom 12 ft long, spaced 72 in. OC. Main runners suspended by min 12 SWG galv steel hanger wires spaced 48 in. OC. Cross tees, nom 6 ft long, installed perpendicular to main runners and spaced 24 in. OC. Additional 6 ft long cross tees required at each gypsum board end joint with butted gypsum board end joints centered between cross tees spaced 8 in. OC. The main runners and cross tees may be riveted or screw attached to the wall angle or channel to facilitate the ceiling installation.
USG INTERIORS LLC — Type DGL or RX

6G. **Alternate Steel Framing Members* —** (Not Shown) - As an alternate to items 6 through 6F furring channels and Steel Framing Members as described below.
a. **Furring Channels —** Formed of No. 25 MSG galv steel, 2-1/2 in. wide by 7/8 in deep, spaced 16 in OC, perpendicular to trusses. When batt insulation (Item 3, 3A or 3B) is draped over the resilient channel/gypsum board ceiling membrane, the resilient channel spacing shall be reduced to 12 in. OC. Channels secured to trusses as described in Item b.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to the wood trusses (Item 2). Clips spaced at 48" OC and secured to the bottom of the trusses with one 2-1/2 in. Coarse Drywall Screw with 1 in. diam washer through the center hole. Furring channels are then friction fitted into clips. Ends of channels are overlapped 6" and tied together with double strand of No. 18 AWG galvanized steel wire. Additional clips are required to hold the Gypsum Butt joints as described in Item 7.
REGUPOL AMERICA — Type SonusClip

6H. **Furring Channels — For use with American Gypsum Co. Type AG-C gypsum board only.** Resilient channels formed of 25 MSG galv steel, spaced 16 in. OC, installed perpendicular to trusses. When insulation material, Item 3, 3A or 3B, is applied over the resilient channel/gypsum board ceiling membrane, the spacing may remain at 16 in. OC. Channels secured to each truss with 1-1/4 in. long Type S steel screws. Channels overlapped 4 in. at splices. Channels oriented opposite at gypsum board butt joints (spaced 6 in. OC) as shown in the above illustration.

7. **Gypsum Board* —** One layer of nom 5/8 in. thick, 48 in. wide, installed with long dimension perpendicular to resilient channels with 1 in. long Type S screws spaced 12 in. OC and located a min of 1/2 in. from side joints and 3 in. from the end joints. At end joints, two resilient channels are used, extending a min of 6 in. beyond both ends of the joint. When insulation (Item 3, 3A, 3B) is draped over the resilient channel/gypsum board ceiling membrane, screws shall be installed at 8 in. OC.
When **Steel Framing Members*** (Item 6A or 6C) are used, sheets installed with long dimension perpendicular to furring channels and side joints of sheet located beneath trusses. Gypsum board screws are driven through channel spaced 12 in. OC in the field when no insulation (Item 3, 3A, 3B) is fitted in the concealed space, or 8 in. OC in the field when insulation (Item 3, 3A, 3B) is fitted in the concealed space, draped over the furring channel/gypsum board ceiling membrane. Gypsum board butt joints shall be staggered min. 2 ft within the assembly, and occur between the main furring channels. At the gypsum board butt joints, each end of the gypsum board shall be supported by a single length of furring channel equal to the width of the gypsum board plus 6 in. on each end. The furring channels shall be spaced approximately 3-1/2 in. OC, and be attached to the trusses with one clip at each end of the channel. Screw spacing along the butt joint to attach the gypsum board to the furring channels shall be 8 in. OC. Second (outer) layer of gypsum board required when furring channels (Item 6A, a) are spaced 24 in. OC and insulation is fitted in the concealed space, draped over the furring channel/gypsum board ceiling membrane. Outer layer of gypsum board attached to the furring channels using 1-5/8 in. long Type S bugle-head screws spaced 8 in. OC at butted joints and 12 in. OC in the field. Butted end joints of outer layer to be offset a minimum of 8 in. from base layer end joints. Butted side joints of outer layer to be offset minimum 18 in. from butted side joints of base layer.

When **Steel Framing Members** (Item 6B) are used, two layers of nom 5/8 in. thick, 4 ft wide gypsum board are installed with long dimensions perpendicular to furring channels (Item 6Ba). Base layer attached to the furring channels using 1 in. long Type S bugle head steel screws spaced 8 in. OC along butted end joints and 12 in. OC in the field of the board. Butted end joints centered on the continuous furring channels. Butted base layer end joints to be offset a min of 16 in. in adjacent courses. Outer layer attached to the furring channels using 1-5/8 in. long Type S bugle head

steel screws spaced 8 in. OC at butted end joints and 12 in. OC in the field. Butted end joints centered on the continuous furring channels and offset a min of 16 in. from butted end joints of base layer. Butted side joints of outer layer to be offset min 16 in. from butted side joints of base layer.

When **Steel Framing Members** (Item 6E) are used, one layer of nom 5/8 in. thick, 4 ft wide gypsum board is installed with long dimensions perpendicular to furring channels. Gypsum board secured to furring channels with nom 1 in. long Type S bugle-head steel screws spaced 8 in. OC in the field of the board. Gypsum board butted end joints shall be staggered minimum 48 in. and centered over main furring channels. At the gypsum board butt joints, each end of each gypsum board shall be supported by a single length of furring channel equal to the width of the gypsum board plus 3 in. on each end. The two support furring channels shall be spaced approximately 3 in. in from end joint. Screw spacing along the gypsum board butt joint and along both additional channels shall be 8 in. OC. Butt joing furring channels shall be attached with one RESILMOUNT Sound Isolation Clip at each end of the channel.

When **Steel Framing Members*** (Item 6F) are used, one layer of nom 5/8 in. thick, 4 ft wide gypsum board sheets installed with long dimension (side joints) perpendicular to the 6 ft long cross tees with the end joints staggered min 4 ft and centered between cross tees which are spaced 8 in. OC. Gypsum board side joints may occur beneath or between main runners. Prior to installation of the gypsum board sheets, backer strips consisting of nom 7-3/4 in. wide pieces of gypsum board are to be laid atop the cross tee flanges and centered over each butted end joint location. The backer strips are to be secured to the flanges of the cross tees at opposite corners of the backer strip with hold down clips to prevent the backer strips from being uplifted during screw-attachment of the gypsum board sheets. Gypsum board fastened to cross tees with 1 in. drywall screws spaced 1 in. and 4 in. from the side joints and max 8 in. OC in the field of the board. The butted end joints are to be secured to the backer strip with No. 10 by 1-1/2 in. long Type G laminating screws located 1 in. from each side of the butted end joint and spaced 1 in. and 4 in. from the side joints and max 8 in. OC in the field of the board.

When **Steel Framing Members** (Item 6G) are used, one layer of nom 5/8 in. thick, 4 ft wide gypsum board is installed with long dimensions perpendicular to furring channels. Gypsum board secured to furring channels with nom 1 in. long Type S bugle-head steel screws spaced 8 in. OC in the field of the board. Gypsum board butted end joints shall be staggered minimum 48 in. and centered over main furring channels. At the gypsum board butt joints, an additional single length of furring channel shall be installed and be spaced approximately 3 in. from the butt joint (6 in. from the continuous furring channels) to support the floating end of the gypsum board. Each of these shorter sections of furring channel shall extend one truss beyond the width of the gypsum panel and be attached to the adjacent trusses with one SonusClip at every truss involved with the butt joint.

AMERICAN GYPSUM CO — Types AG-C

CGC INC — Types C, IP-X2, IPC-AR.

CERTAINTEED GYPSUM INC — Type C

CERTAINTEED GYPSUM INC — Type LGFC-C/A

GEORGIA-PACIFIC GYPSUM L L C — Type TG-C

NATIONAL GYPSUM CO — Types eXP-C, FSW-G, FSW-C, FSK-G, FSK-C.

THAI GYPSUM PRODUCTS PCL — Type C

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR.

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR.

7A. **Gypsum Board* —** For use with **Steel Framing Members** (Item 6D) when **Batts and Blankets*** (Item 3) are not used - One layer of nom 5/8 in. thick by 48 in. wide boards, installed with long dimension parallel to the main runners. Gypsum board fastened to each cross tee or channel with five gypsum board screws, with one screw located at the midspan of the cross tee or channel, one screw located 12 in. from and on each side of the cross tee or channel mid span and one screw located 1-1/2 in. from each gypsum board side joint. Except at gypsum board end joints, gypsum board screws shall be located on alternating sides of cross tee flange. At

gypsum board end joints, gypsum board screws shall be located 1/2 in. from the joint. Gypsum board fastened to main runners with gypsum board screws 1/2 in. from side joints, midway between intersections with cross tees or channels (16 in. OC). End joints of adjacent gypsum board sheets shall be staggered not less than 32 in. Gypsum board sheets screw attached to leg of wall angle with gypsum board screws spaced 12 in. OC. Joints treated as described in Item 7. For use with **Steel Framing Members*** (Item 6D) when **Batts and Blankets*** (Item 3) are used - 5/8 in. thick, 4 ft wide; installed with long dimension perpendicular to cross tees with side joints centered along main runners and end joints centered along cross tees. Fastened to cross tees with 1 in. long steel gypsum board screws spaced 8 in. OC in the field and 8 in. OC along end joints. Fastened to main runners with 1 in. long gypsum board screws spaced midway between cross tees. Screws along sides and ends of boards spaced 3/8 to 1/2 in. from board edge. End joints of the sheets shall be staggered with spacing between joints on adjacent boards not less than 4 ft OC.
CGC INC — Type C or IP-X2.

UNITED STATES GYPSUM CO — Type C or IP-X2.

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Type C or IP-X2.

7B. **Gypsum Board* (As an alternative to Items 7 and 7A) —** Nom 5/8 in. thick, 48 in. wide gypsum board, installed and secured as described in Items 7 and 7A with max screw spacing 8 in. OC.
CGC INC — Type ULIX

UNITED STATES GYPSUM CO — ULIX

7C. **Gypsum Board* —** (As an alternative to Item 7) — For use when no insulation is used. Nom 5/8 in. thick, 48 in. wide gypsum board, installed as described in item 7 with resilient channels (Item 6) spaced 24 in OC.

AMERICAN GYPSUM CO — Type AG-C

8. **Finishing System —** (Not Shown)— Vinyl, dry or premixed joint compound, applied in two coats to joints and screw-heads; paper tape, 2 in. wide, embedded in first layer of compound over all joints. As an alternate, nom 3/32 in. thick veneer plaster may be applied to the entire surface of gypsum board.

9. **Netting —** (Not Shown) - For use when Sprayed Fiber* (Item 3B) is used - Woven netting material fastened to underside of each truss with staples, with side joints overlapped.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2024-02-16

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States
BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

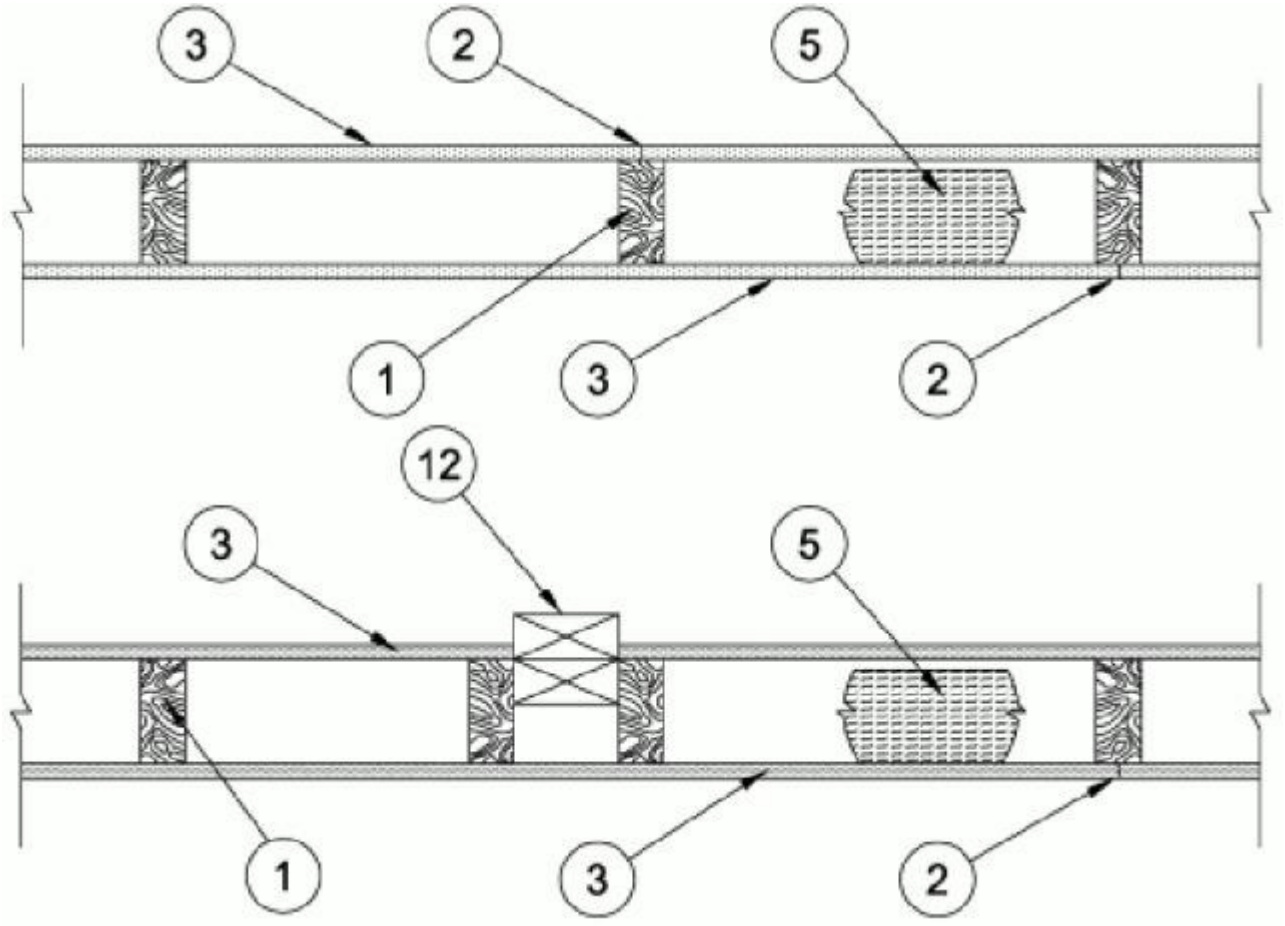
See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. **U305**

February 16, 2024

Bearing Wall Rating — 1 Hr
Finish Rating — See Items 3, 3A, 3D, 3E, 3F, 3G, 3H, 3J and 3L.
STC Rating - 56 (See Item 9)
This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



1. **Wood Studs —** Nom 2 by 4 in. spaced 16 in. OC max, effectively firestopped.

2. **Joints and Nail-Heads —** Joints covered with joint compound and paper tape. Joint compound and paper tape may be omitted when square edge boards are used. As an alternate, nom 3/32 in. thick gypsum veneer plaster may be applied to the entire surface of Classified veneer baseboard with the joints reinforced with paper tape. Nailheads exposed or covered with joint compound.

3. **Gypsum Board* —** 5/8 in. thick paper or vinyl surfaced, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads. When used in widths other than 48 in., gypsum panels are to be installed horizontally. For an alternate method of attachment of gypsum panels, refer to Items 6 through 6F, **Steel Framing Members***.
When Items 6, 6B, 6C, 6D, 6E, or 6F, **Steel Framing Members***, are used, gypsum panels attached to furring channels with 1 in. long Type S bugle-head steel screws spaced 12 in. OC.

When Item 6A, **Steel Framing Members***, is used, two layers of gypsum panels attached to furring channels. Base layer attached to furring channels with 1 in. long Type S bugle-head steel screws spaced 12 in. OC. Face layer attached to furring channels with 1-5/8 in. long Type S bugle-head steel screws spaced 12 in. OC. All joints in face layers staggered with joints in base layers. One layer of gypsum board attached to opposite side of wood stud without furring channels as described in Item 3.

When Item 7, resilient channels are used, 5/8 in. thick, 4 ft wide gypsum panels applied vertically. Screw attached furring channels with 1 in. long, self-drilling, self-tapping Type S or S-12 steel screws spaced 8 in. OC, vertical joints located midway between studs.

AMERICAN GYPSUM CO — Types AGX-1(finish rating 23 min.), M-Glass (finish rating 23 min.), Type AGX-11 (finish rating 26 min), Type AGX-12 (finish rating 22 min), Type LightRoc (finish rating 23 min.) or Type AG-C

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO — Type DBX-1 (finish rating 24 min)

CABOT MANUFACTURING ULC — Type X (finish rating 22 min), 5/8 Type X, Moisture Resistant Type X, Gypsum Sheathing Type X, Mold & Mildew Resistant Type X and Mold & Mildew Resistant AR Type X, Type Blueglass Exterior Sheathing

CERTAINTEED GYPSUM INC — Type C, Type X-1 (finish rating 26 min); Type EGRG or GlasRoc (finish rating 23 min), GlasRoc-2, Type Habito (finish rating 26 min), Type LWTX (finish rating 18 min), Type LGFC6A (finish rating 34 min), Type LGFC2A, Type LGFC-C/A, Type LGFC-WD, Type LGLLX (finish rating 21 min), Type CLLX (finish rating 24 min)

CGC INC — Type AR (finish rating 24 min), Type C (finish rating 24 min), Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SCX (finish rating 24 min), Type SHX (finish rating 24 min), Type ULX (finish rating 22 min), Type WRC (finish rating 24 min), Type WRX (finish rating 24 min), Type ULIX (finish rating 20 min)

GEORGIA-PACIFIC GYPSUM L L C — Type 5 (finish rating 26 min), Type 6 (finish rating 23 min), Type 9 (finish rating 26 min), Type C (finish rating 26 min), Type DGG (finish rating 20 min), Type GPFS1 (finish rating 20 min), Type GPFS2 (finish rating 20 min), Type GPFS6 (finish rating 26 min), Type DS, Type DAP, Type DD (finish rating 20 min), Type DA, Type DAPC, Type LS (finish rating 23 min), Type X, Veneer Plaster Base - Type X, Water Rated - Type X, Sheathing - Type X, Soffit - Type X, Type LWX (finish rating 22 min), Veneer Plaster Base-Type LWX (finish rating 22 min), Water Rated-Type LWX (finish rating 22 min), Sheathing Type-LWX (finish rating 22 min), Soffit-Type LWX (finish rating 22 min), Type DGLW (finish rating 22 min), Water Rated-Type DGLW (finish rating 22 min), Sheathing Type- DGLW (finish rating 22 min), Soffit-Type DGLW (finish rating 22 min), Type LWX (finish rating 22 min), Type LW2X (finish rating 22 min), Veneer Plaster Base - Type LW2X (finish rating 22 min), Water Rated - Type LW2X (finish rating 22 min), Sheathing - Type LW2X (finish rating 22 min), Soffit - Type LW2X (finish rating 22 min), Type DGL2W (finish rating 22 min), Water Rated - Type DGL2W (finish rating 22 min), Sheathing - Type DGL2W (finish rating 22 min)

NATIONAL GYPSUM CO — Type FSK (finish rating 20 min), Type FSK-G (finish rating 20 min), Type FSW (finish rating 20 min), Type FSW-2 (finish rating 24 min), Type FSW-3 (finish rating 20 min), Type FSW-5 (finish rating 22 min), Type FSW-G (finish rating 20 min), Type FSK-C (finish rating 20 min), Type FSW-C (finish rating 20 min), Type FSMR-C, Type FSW-6 (finish rating 20 min), Type FSL (finish rating 24 min), Type FSW-8, Type FSLX (finish rating 21 min), Type RSX (finish rating 26 min).

NATIONAL GYPSUM CO — Riyadh, Saudi Arabia — Type FR, or WR.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Types C, PG-2 (finish rating 20 min), PG-3 (finish rating 20 min), Types PG-3W, PG-5W (finish rating 20 min), Type PG-4 (finish rating 20 min), Type PG-6 (finish rating 23 min), Types PG-3WS, PG-5WS, PGS-WRS (finish rating 20 min), Types PG-5, PG-9 (finish rating 26 min), PG-11 PG-13 (Nails increased to 2 in.), Type PG-C or PGI (finish rating 26 min)

PANEL REY S A — Type ARX, GREX, GRIX, PRX, PRC, PRC2; Types RHX, Guard Rey, MDX, ETX (finish rating 22 min), PRX2 (finish rating 21 min)

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD — Type EX-1 (finish rating 26 min)

THAI GYPSUM PRODUCTS PCL — Type C, Type X (finish rating 26 min)

UNITED STATES GYPSUM CO — Type AR (finish rating 24 min), Type C (finish rating 24 min), Type FRX-G (finish rating 29 min), Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SHX (finish rating 24 min), Type SGX (finish rating 24 min), Type ULX (finish rating 22 min), Type WRX (finish rating 24 min), Type WRC (finish rating 24 min), Type ULIX (finish rating 20 min), Type SCX (finish rating 24 min)

USG BORAL DRYWALL SFZ LLC — Type SGX (finish rating 24 min).

USG MEXICO S A DE C V — Type AR (finish rating 24 min), Type C (finish rating 24 min), Type WRX (finish rating 24 min), Type WRC (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SHX (finish rating 24 min), SCX (finish rating 24 min), Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min), Type ULX (finish rating 22 min)

3A. **Gypsum Board* —** (As an alternate to Item 3) — 5/8 in. thick gypsum panels, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board. When used in widths of other than 48 in., gypsum boards are to be installed horizontally.

AMERICAN GYPSUM CO — Types AGX-1 (finish rating 25 min.), M-Glass (finish rating 25 min.), AG-C (finish rating 25 min.), LighttRoc (finish rating 25 min.)

CERTAINTEED GYPSUM INC — Type C, Type X-1 (finish rating 26 min), Type EGRG or GlasRoc, LWTX.

CGC INC — Type AR (finish rating 24 min), Type C (finish rating 24 min), Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SCX (finish rating 24 min), Type SHX (finish rating 24 min), Type WRC (finish rating 24 min), Type WRX (finish rating 24 min)

NATIONAL GYPSUM CO — Type FSW (finish rating 24 min)

UNITED STATES GYPSUM CO — Type AR (finish rating 24 min), Type SGX (finish rating 24 min), Type C (finish rating 24 min), Type WRX (finish rating 24 min), Type WRC (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SCX (finish rating 24 min), Type SHX (finish rating 24 min), Type FRX-G (finish rating 24 min), Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min)

USG BORAL DRYWALL SFZ LLC — Types C, SCX, SGX (finish rating 24 min).

USG MEXICO S A DE C V — Type AR (finish rating 24 min), Type C (finish rating 24 min), Type WRX (finish rating 24 min), Type WRC (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SHX (finish rating 24 min), Type SCX, Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min)

3B. **Gypsum Board* —** (As an alternate to Item 3) — Nom 3/4 in. thick, installed with 1-7/8 in. long cement coated nails as described in Item 3 or 1-3/8 in. long Type W coarse thread gypsum panel steel screws as described in Item 3A.
CGC INC — Types AR, IP-AR

UNITED STATES GYPSUM CO — Types AR, IP-AR

USG MEXICO S A DE C V — Types AR, IP-AR

3C. **Gypsum Board* —** (As an alternate to Items 3, 3A and 3B) — 5/8 in. thick, 2 ft wide, tongue and groove edge, applied horizontally to one side of the assembly. Installed with 1-7/8 in. long cement coated nails as described in Item 3 or 1-1/4 in. long Type W coarse thread gypsum panel steel screws as described in Item 3A. Joint covering (Item 2) not required.
CGC INC — Type SHX

UNITED STATES GYPSUM CO — Type SHX

USG MEXICO S A DE C V — Type SHX

3D. **Gypsum Board* —** (As an alternate to Items 3, 3A, 3B, or 3C — Not Shown) — For Direct Application to Studs Only- Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-5/8 in. long Type W coarse thread gypsum panel steel screws spaced 8 in. OC at perimeter and in the field. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 1-1/2 in. wide, max 10 ft long with a max thickness of 0.125 in. placed on the face of studs and attached to the stud with two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs or tabs may be used in lieu of or in addition to the lead batten strips or optional at other locations. Max 3/4 in. diam by max 0.125 in. thick lead discs compression fitted or adhered over steel screw heads or max 1/2 in. by 1-1/4 in. by max 0.125 in. thick lead tabs placed on gypsum boards underneath screw locations prior to the installation of the screws. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".
RAY-BAR ENGINEERING CORP — Type RB-LBG (finish rating 24 min)

3E. **Gypsum Board* —** (As an alternate to Items 3, 3A, 3B, 3C, and 3D) — 5/8 in. thick gypsum panels, with square edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last 2 screws 1 and 4 in. from edge of board or nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads. When used in widths of other than 48 in., gypsum boards are to be installed horizontally.
GEORGIA-PACIFIC GYPSUM L L C — Type DGG (finish rating 20 min), GreenGlass Type X (finish rating 23 min)

3F. **Gypsum Board* —** (As an alternate to Items 3, 3A, 3B, 3C, 3D, and 3E) — 5/8 in. glass-mat faced with square edges, applied either horizontally or vertically. Gypsum panels nailed 7 in. OC around the perimeter and in the field with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads. Nails shall be placed 1 inch and 3 inch from horizontal joints and 7 inch OC thereafter.
CGC INC — Type USGX (finish rating 22 min)

UNITED STATES GYPSUM CO — Type USGX (finish rating 22 min.)

USG BORAL DRYWALL SFZ LLC — , Type USGX (finish rating 22 min.)

USG MEXICO S A DE C V — Type USGX (finish rating 22 min.)

3G. **Gypsum Board* —** (As an alternate to Items 3 through 3F) — 5/8 in. thick paper surfaced applied vertically. Gypsum panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads.
GEORGIA-PACIFIC GYPSUM L L C — Type X ComfortGuard Sound Deadening Gypsum Board (finish rating 27 min)

3H. **Gypsum Board* —** (As an alternate to Items 3) — Not to be used with items 6 or 7. 5/8 in. thick paper surfaced applied vertically only. Gypsum panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads.
NATIONAL GYPSUM CO — Type SBWB

3I. **Gypsum Board* —** (As an alternate to Items 3 through 3H, Not Shown) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically. Panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads. Panel joints covered with paper tape and two layers of joint compound. Nailheads covered with two layers of joint compound.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock ES (finish rating 20 min)

3J. **Gypsum Board* —** (As an alternate to Item 3) — 5/8 in. thick paper surfaced applied vertically or horizontally. Gypsum panels secured with 1-1/4 in. Type W coarse thread gypsum panel steel screws spaced a maximum of 12 in. OC.
CERTAINTEED GYPSUM INC — Type SilentFX

3K. **Gypsum Board* —** (As an alternate to Item 3) — 5/8 in. thick gypsum panels, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a maximum 8 in. OC with the last screw 1 in. from the edge of the board. When used in widths other than 48 in., gypsum panels are to be installed horizontally.
NATIONAL GYPSUM CO — Type FSK (finish rating 20 min), Type FSK-G (finish rating 20 min), Type FSW (finish rating 20 min), Type FSW-2 (finish rating 24 min), Type FSW-3 (finish rating 20 min), Type FSW-5 (finish rating 22 min), Type FSW-G (finish rating 20 min), Type FSK-C (finish rating 20 min), Type FSW-C (finish rating 20 min), Type FSMR-C, Type FSW-6 (finish rating 20 min), Type FSL (finish rating 24 min).

3L. **Gypsum Board* —** (As an alternate to Item 3) — For Direct Application to Studs Only — Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-5/8 in. long Type W coarse thread gypsum panel steel screws spaced 8 in. OC at perimeter and in the field. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 10 ft long with a max thickness of 0.140 in. placed on the face of studs and attached to the stud with two 1 in. long Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs, max 5/16 in. diam by max 0.140 in. thick. compression fitted or adhered over the screw heads. Lead batten strips to have a purity of 99.5% meeting the Federal specification QQ-L-201f, Grades "B, C or D".
MAYCO INDUSTRIES INC — "X-Ray Shielded Gypsum"

3M. **Gypsum Board* —** (As an alternate to Items 3) — For Direct Application to Studs Only — For use as the base layer or as the face layer. Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-5/8 in. long Type W coarse thread gypsum panel steel screws spaced 8 in. OC at perimeter and in the field when applied as the base layer. When applied as the face layer screw length to be increased to 2-1/2 in. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 8 ft long with a max thickness of 0.14 in. placed on the face of studs and attached to the stud with construction adhesive and two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs, nominal 3/8 in. diam by max 0.085 in. thick. Compression fitted or adhered over the screw heads. Lead batten strips and discs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Fasteners for face layer gypsum panels (Items 4, 4A or 4B) when installed over lead backed board to be min 2-1/2 in. Type S-12 bugle head steel screws spaced as described in Item 4.
RADIATION PROTECTION PRODUCTS INC — Type RPP - Lead Lined Drywall

3N. **Gypsum Board* —** (As an alternate to Item 3) — 5/8 in. thick, 4 ft. wide, applied horizontally or vertically with vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Secured as described in Item 3 or 3A.
CERTAINTEED GYPSUM INC — Easi-Lite Type X (finish rating 24 min), Easi-Lite Type X-2 (finish rating 24 min)

3O. **Wall and Partition Facings and Accessories* —** (As an alternate to Item 3, Not Shown) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically. Panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads. Panel joints covered with paper tape and two layers of joint compound. Nailheads covered with two layers of joint compound.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock 527 (finish rating 24 min).

3P. **Gypsum Board* —** (As an alternate to Item 3, Not Shown) — Two layers nom. 5/16 in. thick gypsum panels applied vertically or horizontally. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered or backed by wood studs. Horizontal joints on the same side between face and base layers need not be staggered. Base layer gypsum panels fastened to studs with 1-1/4 in. long drywall nails spaced 8 in. OC. Face layer gypsum panels fastened to studs with 1-7/8 in. long drywall nails spaced 8 in. OC starting with a 4" stagger.
NATIONAL GYPSUM CO — Type FSW (finish rating 25 min)

3Q. **Gypsum Board* —** (As an alternate to Item 3) — 5/8 in. thick gypsum panels, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a maximum 10 in. OC with the last two screws 4 and 1 in. from the edges of the board. When used in widths other than 48 in., gypsum panels are to be installed horizontally.
CERTAINTEED GYPSUM INC — Type LGFC6A (finish rating 21 min), Type LGFC2A, Type LGFC-C/A, Type LGFC-WD, Type LGLLX

3R. **Gypsum Board* —** (As an alternate to Item 3. For use with Item 5H) — Any 5/8 in. thick, 4 ft. wide, Gypsum Board listed in Item 3 above. Applied either horizontally or vertically, and screwed to panels with 1-5/8 in. long Type W coarse thread steel screws at 8 in. OC at perimeter and in the field with the last two screws 4 and 3/4 in. from the edges of the board when applied as the base layer. When used in widths other than 48 in., gypsum panels are to be installed horizontally.

3S. **Gypsum Board* —** 3/4 in. thick paper or vinyl surfaced, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels secured as described in Item 3 with nail length increased to 2 in.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type PG-13

3T. **Wall and Partition Facings and Accessories* —** (As an alternate to 5/8 in. thick board as outlined in Item 3) — Nominal 1-3/8 in. thick, 4 ft wide panels, applied vertically or horizontally. Fastened with #6 x 2 in. long drywall screws spaced 8 in. OC along the perimeter and 12 in. OC in the field.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock 545

3U. **Gypsum Board* —** (As an alternate to Item 3 - For use with Foamed Plastic products, Item 5J) — 5/8 in. thick, 4 ft. wide, applied vertically with vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Gypsum panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads.
AMERICAN GYPSUM CO — Types AGX-1

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO — Type DBX-1

CABOT MANUFACTURING ULC — Type X

CERTAINTEED GYPSUM INC — Type X

CGC INC — Type SCX

PANEL REY S A — Type ARX, PRX

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD — Type EX-1

THAI GYPSUM PRODUCTS PCL — Type X

UNITED STATES GYPSUM CO — Types SCX and SGX

USG BORAL DRYWALL SFZ LLC — Types SCX and SGX

USG MEXICO S A DE C V — Type SCX

3V. **Gypsum Board* —** (As an alternate to Item 3. For use with Item 5K) — Any 5/8 in. thick, 4 ft. wide, Gypsum Board listed in Item 3 above. Applied vertically with vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Gypsum panels secured to studs with 1-5/8 in. long Type W coarse thread gypsum panel steel screws spaced 8 in. OC at perimeter and in the field.

3W. **Gypsum Board* —** (As an alternate to Item 3. For use with Item 5L) — Any 5/8 in. thick, 4 ft. wide, Gypsum Board listed in Item 3 above. Applied vertically with vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Gypsum panels secured to studs with 1-1/4 in. long Type W screws spaced 8 in. OC at perimeter and in the field.

4. **Steel Corner Fasteners —** (Optional) — For use at wall corners. Channel shaped, 2 in. long by 1 in. high on the back side with two 1/8 in. wide cleats protruding into the 5/8 in. wide channel, fabricated from 24 gauge galv steel. Fasteners applied only to the end or cut edge (not along tapered edges) of the gypsum board, no greater than 2 in. from corner of gypsum board, max spacing 16 in. OC. Nailed to adjacent stud through tab using one No. 6d cement coated nail per fastener. Corners of wall board shall be nailed to top and bottom plate using No. 6d cement coated nails.

5. **Batts and Blankets* —** (Optional — Required when Item 6A is used (RC-1)) — Glass fiber or mineral wool insulation. Placed to completely or partially fill the stud cavities. When Item 6A is used, glass fiber or mineral wool insulation shall be friction-fitted to completely fill the stud cavities.

CERTAINTEED CORP

JOHNS MANVILLE

KNAUF INSULATION LLC

MANSON INSULATION INC

ROCKWOOL — Types Acoustical Fire Batts and Type AFB, min. density 1.69 pcf / 27.0 kg/m^3

ROCKWOOL MALAYSIA SDN BHD — Type Acoustical Fire Batts

ROCK WOOL MANUFACTURING CO — Delta Board

THERMAFIBER INC — Type SAFB, SAFB FF

5A. **Fiber, Sprayed* —** (Not Shown — Not for use with Item 6) — As an alternate to Batts and Blankets (Item 5) — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product with a nominal dry density of 2.7 lb/ft^3. Alternate Application Method: The fiber is applied without water or adhesive at a nominal dry density of 3.5 lb/ft^3, in accordance with the application instructions supplied with the product. When Item 6B is used, Fiber, Sprayed shall be SANCTUARY.

Applegate Greenfiber Acquisition LLC — Insulmax and SANCTUARY for use with wet or dry application.

5B. **Fiber, Sprayed* —** (Not Shown - Not for use with Item 6) — As an alternate to Batts and Blankets (Item 5) - Spray applied cellulose insulation material. The fiber is applied with water to interior surfaces in accordance with the application instructions supplied with the product. Applied to completely fill the enclosed cavity. Minimum dry density of 4.3 pounds per cubic ft.

NU-WOOL CO INC — Cellulose Insulation

5C. **Batts and Blankets* —** Required for use with resilient channels, Item 7, 3 in. thick mineral wool batts, friction-fitted to fill interior of wall.

THERMAFIBER INC — Type SAFB, SAFB FF

5D. **Glass Fiber Insulation —** (As an alternate to Item 5C) — 3 in. thick glass fiber batts bearing the UL Classification Marking as to Surface Burning and/or Fire Resistance, friction-fitted to fill the interior of the wall. See **Batts and Blankets** (BKNV or BZJZ) Categories for names of Classified companies.

5E. **Batts and Blankets* —** (Required for use with Wall and Partition Facings and Accessories, Item 3D) — Glass fiber insulation, nom 3-1/2 in. thick, min. density of 0.80 pcf, with a flame spread of 25 or less and a smoke developed of 50 or less, friction-fitted to completely fill the stud cavities. See Batts and Blankets Category (BKNV) for names of manufacturers.

5F. **Fiber, Sprayed* —** (Optional, Not Shown — Not for use with Items 6, 6A, 6B, 6C, or 6D) — As an alternate to Batts and Blankets (Item 5) and Item 5A - Spray applied granulated mineral fiber material. The fiber is applied with adhesive, at a minimum density of 4.0 pcf, to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. See **Fiber, Sprayed** (CCAZ).
AMERICAN ROCKWOOL MANUFACTURING, LLC — Type Rockwool Premium Plus

5G. **Fiber, Sprayed* —** (Optional, Not Shown — Not for use with Items 6, 6A, 6B, 6C, or 6D). — As an alternate to Batts and Blankets (Item 5) and Item 5A - Brown Colored Spray applied cellulose fiber. The fiber is applied with water to completely fill the enclosed stud cavity in accordance with the application instructions supplied with the product. The minimum dry density shall be 4.30 lbs/ft^3.
INTERNATIONAL CELLULOSE CORP — Celbar-RL

5H. **Foamed Plastic* —** (Optional -For use with Item 3R) — Spray applied, foamed plastic insulation, at any thickness from partial fill to completely filling stud cavity.
SES FOAM INC — Nexseal™ 2.0 or Nexseal™ 2.0 LE Spray Foam and Sucraseal Spray Foam.

5I. **Fiber, Sprayed* —** (Not Shown — Not for use with Item 6) — As an alternate to Batts and Blankets (Item 5) - Spray-applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. To facilitate the installation of the material, any thin, woven or non-woven netting may be attached by any means possible to the outer face the studs. The material shall reach equilibrium moisture content before the installation of materials on either face of the studs. The minimum dry density shall be 5.79 lbs/ft^3.

Applegate Greenfiber Acquisition LLC— Applegate Advanced Stabilized Cellulose Insulation

5J. **Foamed Plastic* —** (Optional, Not Shown - For use with Item 3U) — Spray applied, foamed plastic insulation, at any thickness from partial fill to completely filling stud cavity.
HOLCIM SOLUTIONS AND PRODUCTS US, LLC — Types GacoEZSpray F4500, GacoProFill FR6500R, Gaco 052N, GacoOnePass F1850, GacoOnePass Low GWP F1880, and Gaco WallFoam 183M

5K. **Foamed Plastic* —** (Optional, Not Shown - For use with Item 3V) — Spray applied, foamed plastic insulation, at any thickness from partial fill to completely filling stud cavity.
CARLISLE SPRAY FOAM INSULATION — Types SealTite ONE, SealTite Pro Closed Cell (CC), SealTite Pro Open Cell (OC), SealTite Pro OCX, SealTite Pro No Trim 21, SealTite Pro One Zero, Foamsulate Closed Cell, Foamsulate OCX, Foamsulate 70, and Foamsulate HFO.

5L. **Foamed Plastic* -** (Optional, Not Shown – For use with Item 3W) - Spray applied, foamed plastic insulation, at any thickness from partial fill to completely filling stud cavity.

BASF CORP – Types Enertite® NM, Enertite® G, FE178®, Spraytite® 178, Spraytite® 81206, Walltite® 200, Walltite® US, Walltite® US-N, Walltite® HP+, Spraytite® Comfort XL, Walltite® XL, and Walltite® MAX.

6. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6a) to studs. Clips spaced 48 in. OC. RSIC-1 and RSIC-1 (2.75) clips secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. RSIC-V and RSIC-V (2.75) clips secured to studs with No. 8 x 1-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips. RSIC-1 and RSIC-V clips for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) and RSIC-V (2.75) clips for use with 2-23/32 in. wide furring channels.
PAC INTERNATIONAL L L C — Types RSIC-1, RSIC-V, RSIC-1 (2.75), RSIC-V (2.75)

6A. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members on one side of studs as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. Batts and Blankets placed in stud cavity as described in Item 5. Two layers of gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Aa) to one side of studs only. Clips spaced 48 in. OC., and secured to studs with two No. 8 x 2-1/2 in. coarse drywall screws, one through the hole at each end of the clip. Furring channels are friction fitted into clips.
KINETICS NOISE CONTROL INC — Type Isomax

6B. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-3/8 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Ba) to studs. Clips spaced 48 in. OC. Genie clips secured to studs with No. 8 x 1-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
PLITEQ INC — Type Genie Clip

6C. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire. Gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Ca) to studs. Clips spaced 48 in. OC., and secured to studs with No. 2 in. coarse drywall screw with 1 in. diam washer through the center hole. Furring channels are friction fitted into clips.
STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237 or A237R

6D. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC, and perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and secured in place with a double strand of No. 18 AWG twisted steel wire. Gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Da) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
REGUPOL AMERICA — Type SonusClip

6E. **Steel Framing Members* —** (Optional, Not Shown) — Resilient channels and Steel Framing Members as described below:
a. **Resilient Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC, and perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and secured in place with two No. 8 15 x 1/2 in. Philips Modified Truss screws spaced 2-1/2 in. from the center of the overlap. Gypsum board attached to resilient channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach resilient channels (Item 6Ea) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Resilient channels are secured to clips with one No. 10 x 1/2 in. pan-head self-drilling screw.
KEENE BUILDING PRODUCTS CO INC - Type RC+ Assurance Clip

6F. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-23/32 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Fa) to studs. Clips spaced 48 in. OC. Clips secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. Furring channels are friction fitted into clips.
CLARKDIETRICH BUILDING SYSTEMS — Type ClarkDietrich Sound Clip

6G. **Steel Framing Members* —** (Optional, Not Shown) — Used as an alternate method to attach resilient channels to wall studs. A resilient sound isolation accessory shall be used at each attachment point of the resilient channels and spaced max 16 in. O.C. Channel ends butted and centered under the structural members and attached with one accessory at each end. Additional accessories used to hold resilient channels that support the gypsum board end joints. The accessory envelops the mounting edge of the resilient channel. The accessory and resilient channel are fastened to the structural members with the screws supplied with the accessory and per the accessory manufacturer's installation instructions.
PAC INTERNATIONAL L L C — Type RC-1 Boost

7. **Furring Channel —** Optional — Not Shown — For use on one side of the wall - Resilient channels, 25 MSG galv steel, spaced vertically 24 in. OC, flange portion screw attached to one side of studs with 1-1/4 in. long diamond shaped point, double lead Phillips head steel screws. When resilient channels are used, insulation, Items 5C or 5D is required.

8. **Caulking and Sealants —** (Not Shown, Optional) — A bead of acoustical sealant applied around the partition perimeter for sound control.

9. **STC Rating —** The STC Rating of the wall assembly is 56 when it is constructed as described by Items 1 through 6, except:

A. Item 2, above — Nailheads Shall be covered with joint compound.

B. Item 2, above — Joints As described, shall be covered with fiber tape and joint compound.

C. Item 5, above — Batts and Blankets* The cavities formed by the studs shall be friction fit with R-19 unfaced fiberglass insulation batts measuring 6-1/4 in. thick and 15-1/4 in. wide.

D. Item 6, above — Steel Framing Members* Type RSIC-1 clips shall be used to attach gypsum board to studs on either side of the wall assembly.

E. Item 8, above — Caulking and Sealants (Not Shown) A bead of acoustical sealant shall be applied around the partition perimeter for sound control.

F. Steel Corner Fasteners (Item 4), Fiber, Sprayed (Items 5A and 5B) and Steel Framing Members (Item 6A), not evaluated as alternatives for obtaining STC rating.

10. **Wall and Partition Facings and Accessories* —** (Optional, Not Shown) — Nominal 1/2 in. thick, 4 ft wide panels, for optional use as an additional layer on one or both sides of the assembly. Panels attached in accordance with manufacturer's recommendations. When the QR-500 or QR-510 panel is installed between the wood framing and the UL Classified gypsum board, the required UL Classified gypsum board layer(s) is/are to be installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock QR-500 and QR-510

11. **Cementitious Backer Units* —** (Optional Item Not Shown — For Use On Face Of 1 Hr Systems With All Standard Items Required) - 7/16 in., 1/2 in., 5/8 in., 3/4 in. or 1 in. thick, min. 32 in. wide. Applied vertically or horizontally with vertical joints centered over studs. Fastened to studs and runners with cement board screws of adequate length to penetrate stud by a minimum of 3/8 in. for steel framing members, and a minimum of 3/4 in. for wood framing members spaced a max of 8 in. OC. When 4 ft. wide boards are used, horizontal joints need not be backed by framing.
NATIONAL GYPSUM CO — Type DuraBacker, PermaBase, DuraBacker Plus, or PermaBase Plus

12. **Non-Bearing Wall Partition Intersection —** (Optional) —Two nominal 2 by 4 in. studs or nominal 2 by 6 in. studs nailed together with two 3 in. long 10d nails spaced a max. 16 in. OC. vertically and fastened to one side of the minimum 2 by 4 in. stud with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Intersection between partition wood studs to be flush with the 2 by 4 in. studs. The wall partition wood studs are to be framed by with a second 2 by 4 in. wood stud fastened with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Maximum one non-bearing wall partition intersection per stud cavity. Non-bearing wall partition stud depth shall be at a minimum equal to the depth of the bearing wall.

13. **Mesh Netting —** (Not Shown) — Any thin, woven or non-woven fibrous netting material attached with staples to the outer face of one row of studs to facilitate the installation of the sprayed fiber from the opposite row.

14. **Mineral and Fiber Board* —** (Optional, Not Shown) — For optional use as an additional layer on one side of wall. Nom 1/2 in. thick, 4 ft wide with long dimension parallel and centered over studs. Attached to framing with 2 in. long Type W steel screws, spaced 12 in. OC. The required UL Classified gypsum board layer(s) is/are to be installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
HOMASOTE CO — Homasote Type 440-32

14A. **Mineral and Fiber Board* —** (Optional, Not Shown) — For use with Items 14B-14E) — For optional use as an additional layer on one side of wall. Nom 1/2 in. thick, 4 ft wide with long dimension parallel and centered over studs. Attached to framing with minimum 1-3/8 in. long ring shanked nails or 1-1/4 in. long Type W steel screws, spaced 12 in. OC along board edges and 24 in. OC in field of board along intermediate framing. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
HOMASOTE CO — Homasote Type 440-32

14B. **Glass Fiber Insulation —** (For use with Item 14A) — 3-1/2 in. thick glass fiber batts bearing the UL Classification Marking as to Surface Burning and/or Fire Resistance, placed to fill the interior of the wall. See Batts and Blankets (BKNV or BZJZ) categories for names of Classified companies.

14C. **Batts and Blankets* —** (As an alternate to Item 14B, For use with Item 14A), 3 in. thick mineral wool batts, placed to fill interior of wall, attached to the 3-1/2 in. face of the studs with staples placed 24 in. OC.
THERMAFIBER INC — Type SAFB, SAFB FF

14D. **Adhesive —** (For use with Item 14A) — Construction grade adhesive applied in vertical, serpentine, nominal 3/8 in. wide beads down the length of both vertical edges of Mineral and Fiber Board (Item 14A).

14E. **Gypsum Board* —** (For use with Item 14A) — 5/8 in. thick, 4 ft wide, applied vertically over Mineral and Fiber Board (Item 14A) with vertical joints located anywhere over stud cavities. Secured to mineral and fiber boards with 1-1/2 in. Type G Screws spaced 8 in. OC along edges of each vertical joint and 12 in. OC in intermediate field of the Mineral and Fiber Board (Item 14A). Secured to outermost studs and bearing plates with 2 in. long Type S screws spaced 8 in. OC. Gypsum Board joints covered with paper tape and joint compound. Screw heads covered with joint compound. Finish Rating 30 Min.
AMERICAN GYPSUM CO — Type AG-C

CGC INC — Types C, IP-X2, IPC-AR

CERTAINTEED GYPSUM INC — Type LGFC-C/A

GEORGIA-PACIFIC GYPSUM L L C — Types 5, DAPC, TG-C

NATIONAL GYPSUM CO — Types FSK-C, FSW-C

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type PG-C

PANEL REY S A — Type PRC

THAI GYPSUM PRODUCTS PCL — Type C

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR

14F. **Mineral and Fiber Board —** (Optional, Not Shown) — For optional use as an additional layer on one side of wall - Nom 1/2 in. thick, 4 ft wide, square edge fiber boards applied vertically to studs on one side of the wall in between the wood studs and the UL Classified Gypsum Board (Item 3). Fiber boards installed with 1-1/4 in. long, Type W, bugle head, coarse thread gypsum board screws spaced 12 in. OC max, with the last screws spaced 2 in. and 6 in. from edge of board. Gypsum board (Item 3) installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
BLUE RIDGE FIBERBOARD INC — SoundStop

14G. **Building Units –** (Optional Item Not Shown – For use over Gypsum Board, Item 3) 1 in., 2 in. or 3 in. thick, 4 ft. wide – Applied vertically or horizontally with vertical joints centered over studs. Fastened to studs and runners with wafer head screws of adequate length to penetrate framing by a minimum of of ¾ in., spaced a max 8 in. o.c.

NATIONAL GYPSUM CO – Type PBCI

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2024-02-16

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States
BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

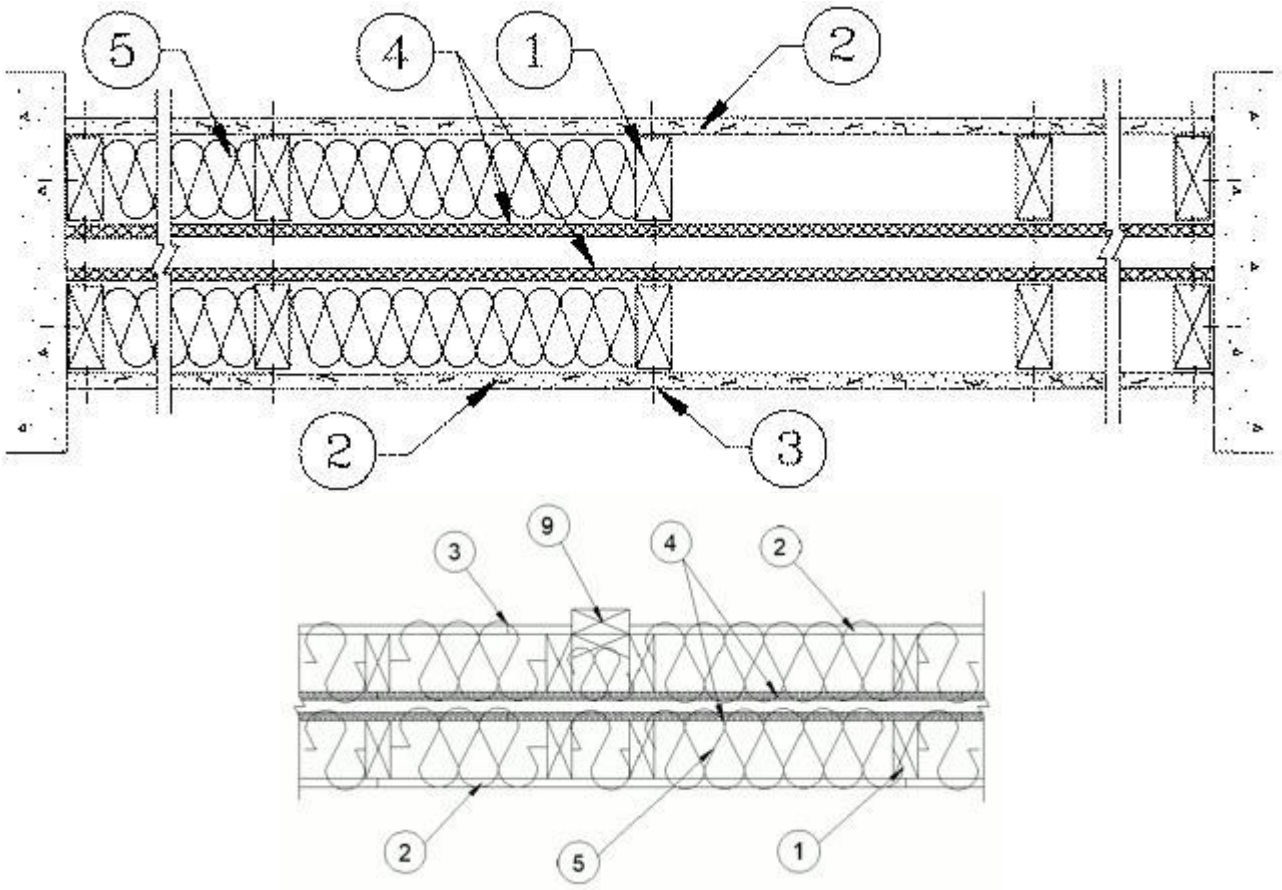
See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. **U341**

January 31, 2024

Bearing Wall Rating — 1 Hr.
Finish Rating — Min 20 min.
This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



HORIZONTAL SECTION

1. **Wood Studs —** Nom 2 by 4 in., spaced 24 in. OC max. Cross braced at mid-height and effectively firestopped at top and bottom of wall. No min. air space between stud rows except to accommodate attachment of sheathing, where required. See items 4 and 5.

2. **Gypsum Board* — Any 5/8 in. thick UL Classified Gypsum Board that is eligible for use in Design Nos. L501, G512 or U305.** Nom 5/8 in. thick 4 ft wide. Gypsum board applied horizontally or vertically, unless specified below, and nailed to studs and bearing plates 7 in. OC with 6d cement coated nails, 1-7/8 in. long, 0.0915 in. shank diam and 1/4 in. diam head. As an alternate, No. 6 bugle head drywall screws, 1-7/8 in. long, may be substituted for the 6d cement coated nails.
When **Steel Framing Members*** (Item 6 or any alternate clips) are used, wallboard attached to furring channels with 1 in. long Type S bugle-head steel screws spaced 12 in. OC.

When used in widths other than 48 in., gypsum board to be installed horizontally.

AMERICAN GYPSUM CO (View Classification) — CKNX.R14196

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO (View Classification) — CKNX.R19374

CABOT MANUFACTURING ULC (View Classification) — CKNX.R25370

CERTAINTEED GYPSUM INC (View Classification) — CKNX.R3660

CGC INC (View Classification) — CKNX.R19751

CERTAINTEED GYPSUM INC (View Classification) — CKNX.R18482

GEORGIA-PACIFIC GYPSUM L L C (View Classification) — CKNX.R2717

NATIONAL GYPSUM CO (View Classification) — CKNX.R3501

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM (View Classification) — CKNX.R7094

PANEL REY S A (View Classification) — CKNX.R21796

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD (View Classification) — CKNX.R19262

THAI GYPSUM PRODUCTS PCL (View Classification) — CKNX.R27517

UNITED STATES GYPSUM CO (View Classification) — CKNX.R1319

USG BORAL DRYWALL SFZ LLC (View Classification) — CKNX.R38438

USG BORAL DRYWALL SFZ LLC (View Classification) — CKNX.R38438

USG MEXICO S A DE C V (View Classification) — CKNX.R16089

2A. **Gypsum Board* —** (As an alternate to Item 2, not shown) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically to studs and bearing plates on one side of the assembly with 1-5/8 in. long Type S screws spaced 12 in. OC at perimeter of panels and 8 in. OC in the field. Horizontal joints of vertically applied panels need not be backed by studs. Panel joints covered with paper tape and two layers of joint compound. Screwheads covered with two layers of joint compound. Batts and Blankets placed in stud cavity as described in Item 5C. Not evaluated for use with Steel Framing Members, Furring Channels or Fiber, Sprayed.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock QR-530 (finish rating 23 min).

2B. **Gypsum Board* —** (As an alternate to Item 2, not shown) — Any 5/8 in. thick gypsum panels that are eligible for use in Design Nos. L501, G512 or U305, supplied by the Classified companies listed below shown in the **Gypsum Board*** (CKNX) category. Applied horizontally or vertically and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board. When used in widths other than 48 in., gypsum board to be installed horizontally.
UNITED STATES GYPSUM CO

USG BORAL DRYWALL SFZ LLC

USG MEXICO S A DE C V

2C. **Gypsum Board* —** (As an alternate to Item 2, Not Shown) — 5/8 in. thick gypsum panels applied horizontally or vertically and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board. When used in widths other than 48 in., gypsum board to be installed horizontally.
AMERICAN GYPSUM CO — Types AGX-1, M-Glass, AG-C, LightRoc

CERTAINTEED GYPSUM INC — Type C or Type X-1

NATIONAL GYPSUM CO — Type FSK, Type FSK-G, Type FSW, Type FSW-3, Type FSW-5, Type FSW-G, Type FSK-C, Type FSW-C, Type FSMR-C, Type FSW-6, Type FSL

THAI GYPSUM PRODUCTS PCL — Type C or Type X

2D. **Gypsum Board* —** (As an alternate to Items 2, 2A, 2B and 2C) — 5/8 in. thick gypsum panels, with square edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last 2 screws 1 and 4 in. from edge of board or nailed as described in Item 2. When used in widths of other than 48 in., gypsum boards are to be installed horizontally.
GEORGIA-PACIFIC GYPSUM L L C — GreenGlass Type X, Type DGG.

2E. **Gypsum Board* —** (As an alternate to Items 2 through 2D) — 5/8 in. thick, 4 ft. wide, paper surfaced applied vertically only and secured as described in Item 2.
GEORGIA-PACIFIC GYPSUM L L C — Type X ComfortGuard Sound Deadening Gypsum Board.

2F. **Gypsum Board* —** (As an alternate to Items 2 through 2E) - Installed as described in Item 2. 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically only and fastened to the studs and plates with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 1/4 in. diam heads, 7 in. OC. Not for use with item #6.
NATIONAL GYPSUM CO — Type SBWB

2G. **Gypsum Board* —** (As an alternate to Items 2 through 2F) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically and secured as described in Item 2.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Types QuietRock ES.

2H. **Gypsum Board* —** (As an alternate to Items 2 through 2G) — Installed as described in Item 2. 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically or horizontally fastened to the studs and plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 12 in. OC.
CERTAINTEED GYPSUM INC — Type SilentFX

2I. **Wall and Partition Facings and Accessories* —** (As an alternate to Items 2 through 2H) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically and secured as described in Item 2.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock 527.

2J. **Gypsum Board* —** (As an alternate to 5/8 in. Type FSW in Item 2) — 2 layers nom. 5/16 in. thick gypsum panels applied vertically or horizontally. Horizontal joints on the same side need not be staggered. Inner layer attached with fasteners, as described in item 2, spaced 24 in. OC. Outer layer attached per Item 2.
NATIONAL GYPSUM CO — Type FSW.

2K. **Gypsum Board* —** (As an alternate to Item 2) — 5/8 in. thick gypsum panels, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a maximum 10 in. OC with the last two screws 4 and 1 in. from the edges of the board. When used in widths other than 48 in., gypsum panels are to be installed horizontally.
CERTAINTEED GYPSUM INC — Type LGFC6A (finish rating 21 min), Type LGFC2A, Type LGFC-C/A, Type LGFC-WD, Type LGLLX

3. **Joints and Nailheads —** Gypsum board joints of outer layer covered with tape and joint compound. Nail heads of outer layer covered with joint compound. As an alternate, nom 3/32 in. thick gypsum veneer plaster may be applied to the entire surface of Classified veneer baseboard with joints reinforced with paper tape.

4. **Sheathing —** (Optional) — Septum may be sheathed with min 7/16 in. thick wood structural panels min grade "C-D" or "Sheathing" or min 1/2 in. thick **Mineral and Fiber Boards***.
See **Mineral and Fiber Boards** (CERZ) category for names of Classified companies.

5. **Batts and Blankets* —** 3-1/2 in. max thickness glass or mineral fiber batt insulation. **Optional** when sheathing (Item 4) is used on both halves of wall.
See **Batts and Blankets** (BZJZ) category for list of Classified companies.

5A. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 5) — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product with a nominal dry density of 2.7 lb/ft^3. Alternate Application Method: The fiber is applied without water or adhesive at a nominal dry density of 3.5 lb/ft^3, in accordance with the application instructions supplied with the product.

Applegate Greenfiber Acquisition LLC — Insulmax and SANCTUARY for use with wet or dry application.

5B. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 5) when Sheathing (Item 4) is used on both halves of wall - Spray applied cellulose insulation material. The fiber is applied with water to interior surfaces in accordance with the application instructions supplied with the product. Applied to completely fill the enclosed cavity. Minimum dry density of 4.3 pounds per cubic ft.

NU-WOOL CO INC — Cellulose Insulation

5C. **Batts and Blankets* —** (Required for use with Wall and Partition Facings and Accessories, Item 2A. Use of Sheathing, Item 4, does not nullify requirement of Item 5C for use with Item 2A) — Glass fiber insulation, nom 3-1/2 in. thick, min. density of 0.80 pcf, with a flame spread of 25 or less and a smoke developed of 50 or less, friction-fitted to completely fill the stud cavities. See Batts and Blankets Category (BKNV) for names of manufacturers.

5D. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 5) and Item 5A when Sheathing (Item 4) is used on both halves of wall - Spray applied cellulose fiber. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. The minimum dry density shall be 4.30 lbs/ft^3.
INTERNATIONAL CELLULOSE CORP — Celbar-RL

5E. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 5) - Spray-applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. To facilitate the installation of the material, any thin, woven or non-woven netting may be attached by any means possible to the outer face the studs. The material shall reach equilibrium moisture content before the installation of materials on either face of the studs. The minimum dry density shall be 5.79 lbs/ft^3.

Applegate Greenfiber Acquisition LLC— Applegate Advanced Stabilized Cellulose Insulation

6. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:
A. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Wallboard attached to furring channels as described in Item 2.

B. **Steel Framing Members* —** Used to attach furring channels (Item a) to studs (Item 1) . Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. Furring channels are friction fitted into clips. RSIC-1 clip for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) clip for use with 2-23/32 in. wide furring channels.
PAC INTERNATIONAL L L C — Types RSIC-1, RSIC-1 (2.75).

6A. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 6) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-3/8 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to studs. Clips spaced 48 in. OC. Genie clips secured to studs with No. 8 x 1-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
PLITEQ INC — Type Genie Clip

6B. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 6) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire. Gypsum board attached to furring channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Ba) to studs. Clips spaced 48 in. OC., and secured to studs with 2 in. coarse drywall screw with 1 in. diam washer through the center hole. Furring channels are friction fitted into clips.
STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237R

6C. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 6) — Furring channels and Steel Framing Members as described below:

A. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item 6Cb. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire. Gypsum board attached to furring channels as described in Item 2.

B. **Steel Framing Members* —** Used to attach furring channels (Item 6CA) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
REGUPOL AMERICA — Type SonusClip

6D. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 6) — Resilient channels and Steel Framing Members as described below:
a. **Resilient Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC, and perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and secured in place with two No. 8 15 x 1/2 in. Philips Modified Truss screws spaced 2-1/2 in. from the center of the overlap. Gypsum board attached to resilient channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach resilient channels (Item 6Da) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Resilient channels are secured to clips with one No. 10 x 1/2 in. pan-head self-drilling screw.
KEENE BUILDING PRODUCTS CO INC — Type RC+ Assurance Clip

6E. **Steel Framing Members* —** (Optional, Not Shown) — Resilient channels and Steel Framing Members as described below:

a. **Resilient Channels —**Formed of No. 25 MSG galv steel, spaced 24 in. OC, and perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board attached to resilient channels as described in Item 2.

b. **Steel Framing Members*** - Used to attach resilient channels to wall studs. A resilient sound isolation accessory shall be used at each attachment point of the resilient channels to the studs. Channel ends butted and centered under the structural members and attached with one accessory at each end. Additional accessories used to hold resilient channels that support the gypsum board end joints. The accessory envelops the mounting edge of the resilient channel. The accessory and resilient channel are fastened to the studs with the screws supplied with the accessory and per the accessory manufacturer's installation instructions.

PAC INTERNATIONAL L L C — Type RC-1 Boost

6F **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 6) — Furring channels and Steel Framing Members as described below:
a **Furring Channels —** Formed of No. 25 MSG galv steel. 2-23/32 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 2.

b **Steel Framing Members* —** Used to attach furring channels (Item 6Fa) to studs. Clips spaced maximum 48 in. OC. Clips secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. Furring channels are friction fitted into clips.

CLARKDIETRICH BUILDING SYSTEMS — Type ClarkDietrich Sound Clip

7. **Wall and Partition Facings and Accessories* —** (Optional, Not shown) — Nominal 1/2 in. thick, 4 ft wide panels, for optional use as an additional layer on one or both sides of the assembly. Panels attached in accordance with manufacturer's recommendations. When the QR-500 or QR-510 panel is installed between the wood framing and the UL Classified gypsum board, the required UL Classified gypsum board layer(s) is/are to be installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock QR-500 and QR-510

8. **Mineral and Fiber Board* —** ((Optional, Not Shown) — For optional use as an additional layer on one or both sides of wall. Nom 1/2 in. thick, 4 ft wide with long dimension parallel and centered over studs. Attached to framing as described in Item 2. The required UL Classified gypsum board layer(s) is/are to be installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.

HOMASOTE CO — Homasote Type 440-32

9. **Non-Bearing Wall Partition Intersection —** (Optional) — Two nominal 2 by 4 in. stud or nominal 2 by 6 in. stud nailed together with two 3in. long 10d nails spaced a max. 16 in. OC. vertically and fastened to one side of the minimum 2 by 4 in. stud with 3 in. long 10d nails spaced a max 16 in. OC. vertically. Intersection between partition wood studs to be flush with the 2 by 4 in. studs. The wall partition wood studs are to be framed by with a second 2 by 4 in. wood stud fastened with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Maximum one non-bearing wall partition intersection per stud cavity. Non-bearing wall partition stud depth shall be at a minimum equal to the depth of the bearing wall.

(Optional, Not Shown) Alternate Construction For Use On One Side Of The Wall.

10. **Mineral and Fiber Board* —** For use with Items 10A-10D) —Nom 1/2 in. thick, 4 ft wide with long dimension parallel and centered over studs. Attached to framing with minimum 1-3/8 in. long ring shanked nails or 1-1/4 in. long Type W steel screws, spaced 12 in. OC along board edges and 24 in. OC in field of board along intermediate framing. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
HOMASOTE CO — Homasote Type 440-32

10A. **Glass Fiber Insulation —** (For use with Item 10) — 3-1/2 in. thick glass fiber batts bearing the UL Classification Marking as to Surface Burning and/or Fire Resistance, placed to fill the interior of the wall. See Batts and Blankets (BKNV or BZJZ) categories for names of Classified companies.

10B. **Batts and Blankets* —** (As an alternate to Item 10B, For use with Item 10), 3 in. thick mineral wool batts, placed to fill interior of wall, attached to the 3-1/2 in. face of the studs with staples placed 24 in. OC.
THERMAFIBER INC — Type SAFB, SAFB FF

10C. **Adhesive —** (For use with Item 10) — Construction grade adhesive applied in vertical, serpentine, nominal 3/8 in. wide beads down the length of both vertical edges of Mineral and Fiber Board (Item 14A).

10D. **Gypsum Board* —** (For use with Item 10) — 5/8 in. thick, 4 ft wide, applied vertically over Mineral and Fiber Board (Item 14A) with vertical joints located anywhere over stud cavities. Secured to mineral and fiber boards with 1-1/2 in. Type G Screws spaced 8 in. OC along edges of each vertical joint and 12 in. OC in intermediate field of the Mineral and Fiber Board (Item 10). Secured to outermost studs and bearing plates with 2 in. long Type S screws spaced 8 in. OC. Gypsum Board joints covered with paper tape and joint compound. Screw heads covered with joint compound. Finish Rating 30 Min.
AMERICAN GYPSUM CO — Type AG-C

CERTAINTEED GYPSUM INC — Type C

CERTAINTEED GYPSUM INC — Type LGFC-C/A

GEORGIA-PACIFIC GYPSUM L L C — Types 5, DAPC, TG-C

NATIONAL GYPSUM CO — Types FSK-C, FSW-C

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type PG-C

PANEL REY S A — Type PRC

THAI GYPSUM PRODUCTS PCL — Type C

UNITED STATES GYPSUM CO —Types C, IP-X2, IPC-AR

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2024-01-31

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States
BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

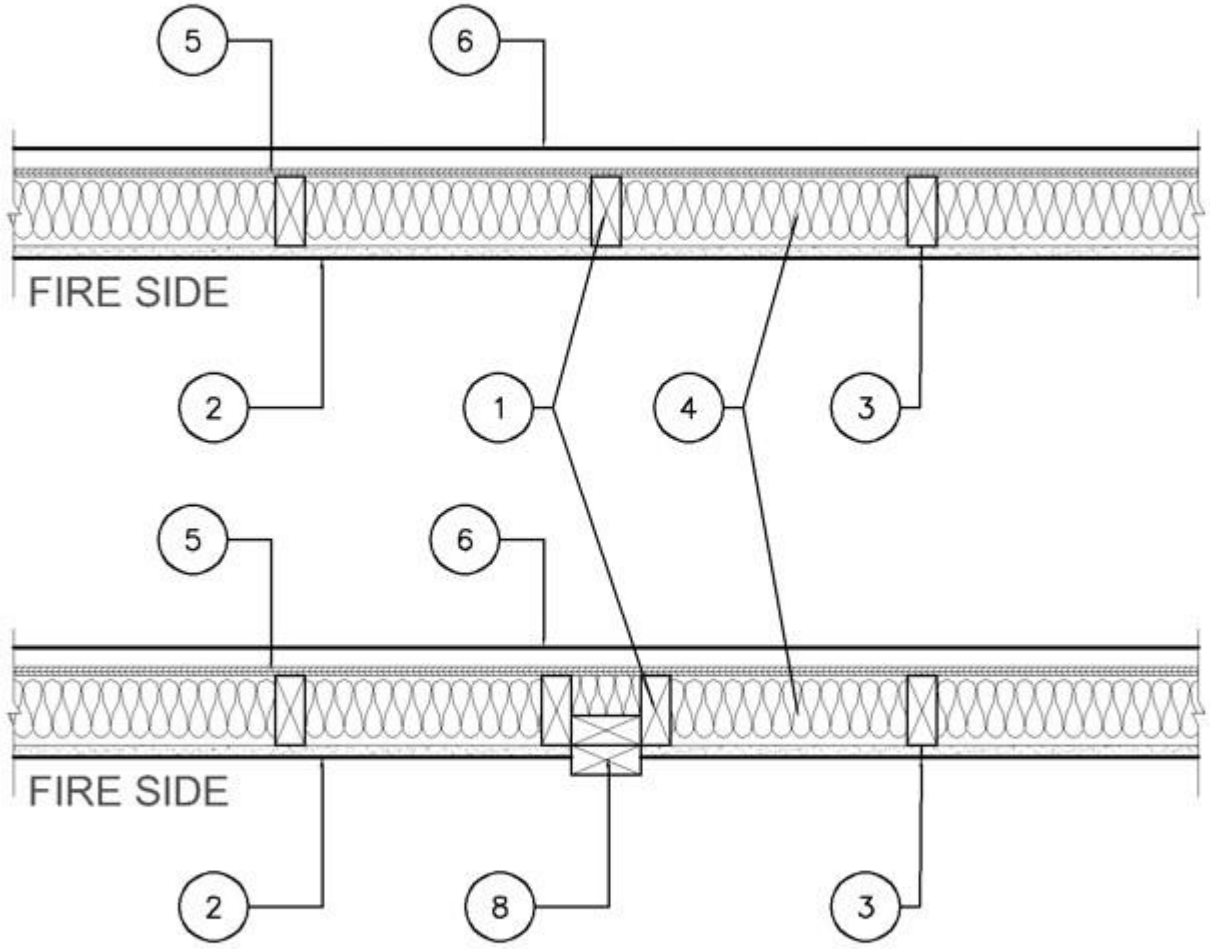
See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. **U356**

January 29, 2024

Bearing Wall Rating - 1 Hr Rating Exposed to Fire on Interior Face Only
Bearing Wall Rating — 1 Hr Rating Exposed to Fire on Exterior Face (See Item 6E)
Finish Rating — 23 Min or 25 Min (See Item 2C)
This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



1. **Wood Studs —** Nom 2 by 4 in. spaced 16 in. OC with two 2 by 4 in. top and one 2 by 4 in. bottom plates. Studs laterally-braced by wood structural panel sheathing (Item 5). When **Mineral and Fiber Boards*** (Item 5A) are considered as bracing for the studs, the load is restricted to 76% of allowable axial load. Walls effectively fire stopped at top and bottom of wall.

2. **Gypsum Board* — Any 5/8 in. thick UL Classified Gypsum Board that is eligible for use in Design Nos. L501, G512 or U305.** Nom 5/8 in. thick, 4 ft wide, applied vertically and nailed to studs and bearing plates 7 in. OC with 6d cement-coated nails, 1-7/8 in. long with 1/4 in. diam head.

When Item **Steel Framing Members*** (Item 7 or any alternate clips), is used, gypsum panels attached to furring channels with 1 in. long Type S bugle-head steel screws spaced 12 in. OC.

When Item 7A **Steel Framing Members***, is used, two layers of gypsum panels attached to furring channels. Base layer attached to furring channels with 1 in. long Type S bugle-head steel screws spaced 12 in. OC. Face layer attached to furring channels with 1-5/8 in. long Type S bugle-head steel screws spaced 12 in. OC. All joints in face layers staggered with joints in base layers.

AMERICAN GYPSUM CO (View Classification) — CKNX.R14196

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO (View Classification) — CKNX.R19374

CABOT MANUFACTURING ULC (View Classification) — CKNX.R25370

CERTAINTEED GYPSUM INC (View Classification) — CKNX.R3660

CGC INC (View Classification) — CKNX.R19751

CERTAINTEED GYPSUM INC (View Classification) — CKNX.R18482

GEORGIA-PACIFIC GYPSUM L L C (View Classification) — CKNX.R2717

NATIONAL GYPSUM CO (View Classification) — CKNX.R3501

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM (View Classification) — CKNX.R7094

PANEL REY S A (View Classification) — CKNX.R21796

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD (View Classification) — CKNX.R19262

THAI GYPSUM PRODUCTS PCL (View Classification) — CKNX.R27517

UNITED STATES GYPSUM CO (View Classification) — CKNX.R1319

USG BORAL DRYWALL SFZ LLC (View Classification) — CKNX.R38438

USG MEXICO S A DE C V (View Classification) — CKNX.R16089

2A. **Gypsum Board* —** (As an alternate to Item 2, Not Shown) — Any 5/8 in. thick 4 ft wide gypsum panels that are eligible for use in Design Nos. L501, G512 or U305, supplied by the Classified Companies listed below shown in the **Gypsum Board*** (CKNX) category. Applied vertically and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board.

CGC INC

UNITED STATES GYPSUM CO

USG BORAL DRYWALL SFZ LLC

USG MEXICO S A DE C V

2B. **Gypsum Board* —** (As an alternate to Item 2, Not Shown) — 5/8 in. thick 4 ft wide gypsum panels applied vertically and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board.

AMERICAN GYPSUM CO — Types AGX-1, M-Glass, AG-C, LightRoc

CABOT MANUFACTURING ULC — Type X, 5/8 Type X, Type Blueglass Exterior Sheathing

CERTAINTEED GYPSUM INC — Type C, Type X-1, Easi-Lite Type X-2

GEORGIA-PACIFIC GYPSUM L L C — Types X, Veneer Plaster Base-Type X, Water Rated-Type X, Sheathing Type-X, Soffit-Type X, Type X ComfortGuard Sound Deadening Gypsum Board.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Types PG-11, PGS-WRS, PGI.

THAI GYPSUM PRODUCTS PCL — Type C or Type X

2C. **Gypsum Board* —** (As an alternate to Item 2, Not Shown) — For Use with Item 5A only - 5/8 in. thick 4 ft wide gypsum panels applied horizontally and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screws 1 in.and 4 in. from edges of board. Finish Rating is 25 min.
CABOT MANUFACTURING ULC — 5/8 Type X, Type Blueglass Exterior Sheathing

GEORGIA-PACIFIC GYPSUM L L C — Type X, Veneer Plaster Base-Type X, Water Rated-Type X, Sheathing Type-X, Soffit-Type X

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Types PG-11, PGS-WRS, PGI

2D. **Gypsum Board* —** (As an alternate to Item 2) — Not to be used with item 7. 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically only and fastened to the studs and plates with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 1/4 in. diam heads, 7 in. OC.
NATIONAL GYPSUM CO — Type SBWB

2E **Gypsum Board* —** (As an alternate to Items 2 through 2D) — Nominal 5/8 in. thick, 4 ft wide panels, secured as described in Item 2.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock ES.

2F. **Gypsum Board* —** (As an alternate to Item 2) — Not to be used with item 7. 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically or horizontally and fastened to the studs and plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board.
CERTAINTEED GYPSUM INC — Type SilentFX

2G. **Wall and Partition Facings and Accessories* —** (As an alternate to Items 2 through 2F) — Nominal 5/8 in. thick, 4 ft wide panels, secured as described in Item 2.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock 527.

2H. **Gypsum Board* —** (As an alternate to Item 2) — 5/8 in. thick gypsum panels, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a maximum 10 in. OC with the last two screws 4 and 1 in. from the edges of the board. When used in widths other than 48 in., gypsum panels are to be installed horizontally.
CERTAINTEED GYPSUM INC — Type LGFC6A (finish rating 21 min), Type LGFC2A, Type LGFC-C/A, Type LGFC-WD, Type LGLLX

2I. **Gypsum Board* —** (As an alternate to Item 2) — 5/8 in. thick gypsum panels, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board. When used in widths of other than 48 in., gypsum boards are to be installed horizontally.
AMERICAN GYPSUM CO — Types AGX-1 (finish rating 25 min.), M-Glass (finish rating 25 min.), AG-C (finish rating 25 min.), LightRoc (finish rating 25 min.)

NATIONAL GYPSUM CO — Type FSK, Type FSK-G, Type FSW, Type FSW-3, Type FSW-5, Type FSW-G, Type FSK-C, Type FSW-C, Type FSMR-C, Type FSW-6, Type FSL

2J. **Gypsum Board* —** (As an alternate to Item 2) - 5/8 in. thick gypsum panels, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread steel screws spaced a max 8 in. OC with the last screw 1 in. from edge of board. When used in widths other than 48 in., gypsum boards are to be installed horizontally.
CERTAINTEED GYPSUM INC — Type C, Type X-1(finish rating 26 min), Easi-Lite Type X (finish rating 24 min), Easi-Lite Type X-2, Type EGRG or GlasRoc or GlasRoc Sheathing (finish rating 23 min)

3. **Joints and Fastener Heads —** (Not Shown) — Gypsum board joints covered with tape and joint compound. Fastener heads covered with joint compound.

4. **Batts and Blankets* —** Mineral fiber or glass fiber insulation, 3-1/2 in. thick, pressure fit to fill wall cavities between studs and plates. Mineral fiber insulation to be unfaced and to have a min density of 3 pcf. Glass fiber insulation to be faced with aluminum foil or kraft paper and to have a min density of 0.9 pcf (min R-13 thermal insulation rating).
See **Batts and Blankets*** (BKNV) Category in the Building Materials Directory and **Batts and Blankets*** (BZJZ) Category in the Fire Resistance Directory for names of Classified Companies.

4A. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 4) — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product with a nominal dry density of 2.7 lb/ft^3. Alternate Application Method: The fiber is applied without water or adhesive at a nominal dry density of 3.5 lb/ft^3, in accordance with the application instructions supplied with the product.
Applegate Greenfiber Acquisition LLC — Insulmax and SANCTUARY are to be used for dry application only.

4B. **Fiber, Sprayed* —** As an alternate to Item 4 and 4A — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. Nominal dry density of 4.58 lb/ft ^{3}.
NU-WOOL CO INC — Cellulose Insulation

4C. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 4) — Spray applied cellulose fiber. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. The minimum dry density shall be 4.30 lbs/ft^3.
INTERNATIONAL CELLULOSE CORP — Celbar-RL

4D. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 4) — Spray applied, granulated mineral fiber material. The fiber is applied with adhesive, at a minimum density of 4.0 pcf, to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. See Fiber, Sprayed (CCAZ).
AMERICAN ROCKWOOL MANUFACTURING, LLC — Type Rockwool Premium Plus

5. **Wood Structural Panel Sheathing —** Min 7/16 in. thick, 4 ft wide wood structural panels, min grade "C-D" or "Sheathing". Installed with long dimension of sheet (strength axis) or face grain of plywood parallel with or perpendicular to studs. Vertical joints centered on studs. Horizontal joints backed with nom 2 by 4 in. wood blocking. Attached to studs on exterior side of wall with 6d cement coated box nails spaced 6 in. OC at perimeter of panels and 12 in. OC along interior studs.

5A. **Mineral and Fiber Boards* —** As an alternate to Item 5 - Min 1/2 in. thick, 4 ft wide sheathing, installed vertically to studs. Vertical joints centered on studs. Horizontal joints backed with nom 2 by 4 in. wood blocking. Attached to studs on exterior side of wall with 1-1/2 in. long galvanized roofing nails spaced 6 in. OC at perimeter of panels and 12 in. OC along interior studs. As an option a weather resistive barrier may be applied over the Mineral and Fiber Boards.

6. **Exterior Facings —** Installed in accordance with the manufacturer's installation instructions. One of the following exterior facings is to be applied over the sheathing:
A. **Vinyl Siding — Molded Plastic* —** Contoured rigid vinyl siding having a flame spread value of 20 or less.
See **Molded Plastic** (BTAT) category in the Building Materials Directory for names of manufacturers.

B. **Particle Board Siding —** Hardboard exterior sidings including patterned panel or lap siding.

C. **Wood Structural Panel or Lap Siding —** APA Rated Siding, Exterior, plywood, OSB or composite panels with veneer faces and structural wood core, per PS 1 or APA Standard PRP-108, including textured, rough sawn, medium density overlay, brushed, grooved and lap siding.

D. **Cementitious Stucco —** Portland cement or synthetic stucco systems with self-furring metal lath or adhesive base coat. Thickness from 3/8 to 3/4 in., depending on system.

E. **Brick Veneer —** Any type on nom 4 in. wide brick veneer. When brick veneer is used, the rating is applicable with exposure on either face. Brick veneer fastened with corrugated metal wall ties attached over sheathing to wood studs with 8d nail per tie: ties spaced not more than each sixth course of brick and max 32 in. OC horizontally. One in. air space provided between brick veneer and sheathing.

F. **Exterior Insulation and Finish System (EIFS) —** Nom 1 in. **Foamed Plastic*** insulation bearing the UL Classification Marking, attached over sheathing and finished with coating system, or Portland cement or synthetic stucco systems, in accordance with manufacturer's instructions. See **Foamed Plastic** (BRYX and CCVW) categories for names of Classified companies.

G. **Siding —** Aluminum or steel siding attached over sheathing to studs.

H. **Fiber-Cement Siding —** Fiber-cement exterior sidings including smooth and patterned panel or lap siding.

I. **Wall and Partition Facings and Accessories* —** Stone veneer is mortar bonded to a lath, scratch coat and water resistant barrier applied to sheathing, installed in accordance with the manufacturers installation instructions, and meeting the requirements of local code agencies.
ELDORADO STONE OPERATIONS L L C — Type Eldorado Stone

J. **Cementitious Backer Units —** 1/2 in. or 5/8 in., min. 32 in. wide.- Applied vertically or horizontally with vertical joints centered over studs. Fastened to studs and runners with cement board screws of adequate length to penetrate stud by a minimum 3/4 in., spaced a max of 8 in. OC. Horizontal joints need not be backed by framing. When Cementitious Backer Units are used, the rating is applicable with exposure on either face. Cementitious Backer Units for use as substrate for exterior finishes such as ceramic tile, slate, marble, natural stone, manufactured stone, thin brick, or Portland cement or synthetic stucco.
NATIONAL GYPSUM CO — Type PermaBase

K. **Building Units –** 1 in., 2 in. or 3 in. thick, 4 ft. wide composite exterior cement backer board with rigid insulation, finished with ceramic tile, marble, natural stone, manufactured stone, thin brick, Portland cement or synthetic stucco.

NATIONAL GYPSUM CO – Type PBCI

6A. **Building Units* — As an alternate to Exterior Facing Item 6 —** Insulated steel panels, 12 through 42 in. wide. Attached over sheathing through retainer clips to studs or support steel with No. 14 hex head self-tapping screws located at each joint in the concealed lip of the units and spaced in accordance with the structural design requirements.

KINGSPAN INSULATED PANELS INC — Types KS series with Kingspan PIR core, 3in. nominal thickness; or Designwall 2000 or Designwall 4000D, 2 or 3 in. nominal thickness.

7. **Steel Framing Members* —** (Optional, Not Shown) — Furring Channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7A) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. Furring channels are friction fitted into clips. RSIC-1 clip for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) clip for use with 2-23/32 in. wide furring channels.
PAC INTERNATIONAL L L C — Types RSIC-1, RSIC-1 (2.75).

7A. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 7) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. Two layers of gypsum board attached to furring channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Aa) to interior side of studs. Clips spaced 48 in. OC., and secured to studs with two No. 8 x 2-1/2 in. coarse drywall screws, one through the hole at each end of the clip. Furring channels are friction fitted into clips.
KINETICS NOISE CONTROL INC — Type Isomax.

7B. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 7) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-3/8 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to studs. Clips spaced 48 in. OC. Genie clips secured to studs with No. 8 x 1-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
PLITEQ INC — Type Genie Clip

7C. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 7) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire.Gypsum board attached to furring channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Ca) to studs. Clips spaced 48 in. OC., and secured to studs with 2 in. coarse drywall screw with 1 in. diam washer through the center hole. Furring channels are friction fitted into clips.
STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237R

7D. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 7) — Furring channels and Steel Framing Members as described below:
a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item 7Db. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire. Gypsum board attached to furring channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Da) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
REGUPOL AMERICA — Type SonusClip

7E. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 7) — Resilient channels and Steel Framing Members as described below:
a. **Resilient Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC, and perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and secured in place with two No. 8 15 x 1/2 in. Philips Modified Truss screws spaced 2-1/2 in. from the center of the overlap. Gypsum board attached to resilient channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach resilient channels (Item 7Ea) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Resilient channels are secured to clips with one No. 10 x 1/2 in. pan-head self-drilling screw.
KEENE BUILDING PRODUCTS CO INC — Type RC+ Assurance Clip

7F **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 7) — Furring channels and Steel Framing Members as described below:
a **Furring Channels —** Formed of No. 25 MSG galv steel. 2-23/32 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 2.

b **Steel Framing Members* —** Used to attach furring channels (Item 7Fa) to studs. Clips spaced maximum 48 in. OC. Clips secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. Furring channels are friction fitted into clips.

CLARKDIETRICH BUILDING SYSTEMS — Type ClarkDietrich Sound Clip

8. **Non-Bearing Wall Partition Intersection —** (Optional) — Two nominal 2 by 4 in. stud or nominal 2 by 6 in. stud nailed together with two 3in. long 10d nails spaced a max. 16 in. OC. vertically and fastened to one side of the minimum 2 by 4 in. stud with 3 in. long 10d nails spaced a max 16 in. OC. vertically. Intersection between partition wood studs to be flush with the 2 by 4 in. studs. The wall partition wood studs are to be framed by with a second 2 by 4 in. wood stud fastened with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Maximum one non-bearing wall partition intersection per stud cavity. Non-bearing wall partition stud depth shall be at a minimum equal to the depth of the bearing wall.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2024-01-29

Overview (Design Phase)

Batch Submission:	☐
Builder Name:	Douglas Station Partners
Physical Address of Home:	Nw Sloan & NE Sycamore
Community/Lot #:	Douglas Station
City:	Lees Summit
State:	Missouri
County:	Jackson
Zip:	64064

Climate Zone:
4 Moist

Radon
1

Single-Family or Multifamily:	Multifamily
Number of Units:	154
Building includes commercial space pursuing Commercial Space certification?	No
Project Name:	Douglas Station
Above grade plane finished floor area:	860 s.f./unit
Total conditioned floor area:	130776 s.f.
Stories above grade:	3
Project Elevation (ft. above sea level):	670 ft.

Calculate per ANSI Z765. For a multifamily building, use a weighted average of the individual unit sizes.

Project Description (optional):	New construction portion of the project: scored from plans dated 9/23/2022, Rev 2/14/23; new updates from 3-22-24 %50 CD plans
Foundation Type:	Slab on grade
Type of Heating System (main system):	Heat Pump
Type of Heating System (system 2):	None
Type of Heating System (system 3):	None
Primary Heating Fuel:	Electricity
Heating Ducts:	Ducted
Type of Cooling System (main system):	Heat Pump
Type of Cooling System (system 2):	None
Type of Cooling System (system 3):	None
Cooling Ducts:	Ducted
Maximum window and door SHGC:	0.3
Maximum skylight SHGC:	0
Maximum window and door U-value:	0.32
Maximum skylight U-value:	0
Renewable Energy:	None
Thermal Envelope Insulation:	Fiberglass
Attic Type:	Sealed
Attached Garage:	No
Recessed Lighting:	No

Exclude south-facing glass if part of "Sun-tempered" design (703.7.1).

Table 703.2.5.2(a), 703.2.5.2(b), 703.2.5.2(c)

Special Design Features:

Passive Solar:	No
Mass Walls:	No
Radiant/Hydronic:	No
Tankless Water Heater:	No
Composting Toilet:	No
Local Energy Code:	2018 IECC
Local Building Code:	2018 IBC
Who completed this information?	SA

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Current Chapter level: Silver	**Total Points: 84**
Points away from: Bronze: 0, Silver: 0, Gold: 9, Emerald: 37	
Add'l pts earned above: Bronze: 34, Silver: 20, Gold: 0, Emerald: 0	
Total Chapter Points needed for: Bronze: 50, Silver: 64, Gold: 93, Emerald: 121	
Revision Date: 2/28/2024	

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Practice #	Chapter 5: Lot Design, Preparation, and Development	Points Available	Points Claimed	Status	Notes
500 LOT DESIGN, PREPARATION AND DEVELOPMENT					
500.0	**500.0 Intent.** This section applies to lot development for the eventual construction of residential buildings, multifamily buildings, or additions thereto that contain dwelling units or sleeping units.				
501 LOT SELECTION					
501.1	**501.1 Lot.** Lot is selected in accordance with § 501.1(1) or § 501.1(2).		10	Certified Site:	
(1)	A lot is selected within a site certified to this Standard or equivalent	**15**		☐	
(2)	A lot is selected to minimize environmental impact by one or more of the following:				
(a)	An infill lot is selected.	**10**		☑	
(b)	A lot is selected that is a greyfield.	**10**		☐	
(c)	An EPA-recognized brownfield lot is selected.	**15**		☐	
501.2	**501.2 Multi-modal transportation.** A range of multi-modal transportation choices are promoted by one or more of the following:				
(1)	A lot is selected within one-half mile (805 m) of pedestrian access to a mass transit system	**6**	0	☐	
(2)	A lot is selected within five miles (8,046 m) of a mass transit station with provisions for parking.	**3**	0	☐	
(3)	Walkways, street crossings, and entrances designed to promote pedestrian activity are provided. New buildings are connected to existing sidewalks and areas of development.	**5**	0	☐	
(4)	A lot is selected within one-half mile (805 m) of six or more community resources No more than two each of the following use category can be counted toward the total: Recreation, Retail, Civic, and Services. Examples of resources in each category include, but are not limited to the following:			☑	bank, grocery, gas, hospital, retail, church, restaurant
	Recreation: recreational facilities (such as pools, tennis courts, basketball courts), parks.	**4**	4		
	Retail: grocery store, restaurant, retail store.				
	Civic: post office, place of worship, community center.				
	Services: bank, daycare center, school, medical/dental office, laundromat/dry cleaners.				
	NOTE: List the 6 community resources in the Notes field.				
	OR				
	A lot is selected within a census block group that, compared to its region, has above-average neighborhood walkability using an index within the EPA's Smart Location Database:		0		
	(a) Walkability is within the top quartile for the region.	**5**			
	(b) Walkability is within the second quartile for the region.	**2**			
(5)	Bicycle use is promoted by building on a lot located within a community that has rights-of-way specifically dedicated to bicycle use in the form of paved paths or bicycle lanes, or on an infill lot located within 1/2 mile of a bicycle lane designated by the jurisdiction.	**5**	0	☐	
(6)	Dedicated bicycle parking and racks are indicated on the site plan and constructed for mixed-use and multifamily buildings:		0		
(a)	Minimum of 1 bicycle parking space per 3 residential units	**2**			
(b)	Minimum of 1 bicycle parking space per 2 residential units	**4**			
(c)	Minimum of 1 bicycle parking space per 1 residential unit.	**6**			
(d)	Bicycle enclosed storage is provided or parking spaces are covered or otherwise protected from the elements	**2 per (a)-(c)**	0	☐	
(7)	Select a lot in a community where there is access to shared vehicle usage such as carpool drop-off areas, car-share services, and shuttle services to mass transit.	**5**	0	☐	
	NOTE: Enter name of car sharing program.				
(8)	Lot is within 1/2 mile walking distance of where a bike sharing program is provided.	**5**	0	☐	
	NOTE: Enter name of bike sharing program.				
502 PROJECT TEAM, MISSION STATEMENT, AND GOALS					
502.1	**502.1 Project team, mission statement, and goals.** A knowledgeable team is established and team member roles are identified with respect to green lot design, preparation, and development. The project's green goals and objectives are written into a mission statement.	**4**	4	☑	
503 LOT DESIGN					
503.0	**503.0 Intent.** The lot is designed to avoid detrimental environmental impacts first, to minimize any unavoidable impacts, and to mitigate for those impacts that do occur. The project is designed to minimize environmental impacts and to protect, restore, and enhance the natural features and environmental quality of the lot.				
	(Points awarded only if the intent of the design is implemented.)				
503.1	**503.1 Natural resources.** Natural resources are conserved by one or more of the following:				
(1)	A natural resources inventory is completed under the direction of a qualified professional.	**5**	0	☐	
(2)	A plan is implemented to conserve the elements identified by the natural resource inventory as high-priority resources.	**6**	0	☐	
(3)	Items listed for protection in the natural resource inventory plan are protected under the direction of a qualified professional.	**4**	0	☐	
(4)	Basic training in tree or other natural resource protection is provided for the on-site supervisor.	**4**	0	☐	
(5)	All tree pruning on-site is conducted by a certified arborist or other qualified professional.	**3**	0	☐	
(6)	Ongoing maintenance of vegetation on the lot during construction is in accordance with TCIA A300 or locally accepted best practices.	**4**	0	☐	
(7)	Where a lot adjoins a landscaped common area, a protection plan from construction activities next to the common area is implemented.	**5**	0	☐	
(8)	Developer has a plan to design and construct the lot in accordance with the International Wildland-Urban Interface Code (IWUIC). *[Only applicable where the AHJ has not declared a wildland-urban interface area, but a fire protection engineer, certified fire marshal, or other qualified party has determined and documented the site as hazarded per the IWUIC].*	**6**	0	☐	
503.2	**503.2 Slope disturbance.** Slope disturbance is minimized by one or more of the following:			Max Slope in Const. Zn:	
	Note: Points are only available for lots with slopes of 25% or greater.			5%	
(1)	The use of terrain adaptive architecture.	**5**	0	☐	
(2)	Hydrological/soil stability study is completed and used to guide the design of all buildings on the lot.	**5**	0	☐	
(3)	All or a percentage of driveways and parking are aligned with natural topography to reduce cut and fill.		0		
(a)	10 percent to < 25 percent	**1**			
(b)	25 percent to 75 percent	**4**			
(c)	greater than 75 percent	**6**			
(4)	Long-term erosion effects are reduced through the design and implementation of clustering, terracing, retaining walls, landscaping, or restabilization techniques.	**6**	0	☐	
(5)	Underground parking uses the natural slope for parking entrances.	**5**	0	☐	

503.3		**503.3 Soil disturbance and erosion.** Soil disturbance and erosion are minimized by one or more of the following: (also see Section 504.3)				
		Note: Points must be earned in 503.3 in order for points in 504.1 to be available				
	(1)	Construction activities are scheduled such that disturbed soil that is to be left unworked for more than 21 days is stabilized within 14 days..	**5**	5	☑	
	(2)	At least 75% of total length of the utilities on the lot are designed to use one or more alternative means:				
	(a)	tunneling instead of trenching			☐	
	(b)	use of smaller (low ground pressure) equipment or geomats to spread the weight of construction equipment	**5**	5	☐	
	(c)	shared utility trenches or easements			☑	
	(d)	placement of utilities under paved surfaces instead of yards			☑	
	(3)	Limits of clearing and grading are demarcated on the lot plan.	**5**	5	☑	
503.4		**503.4 Stormwater Management.** The stormwater management system is designed to use low impact development/green infrastructure practices to preserve, restore or mitigate changes in site hydrology due to land disturbance and the construction of impermeable surfaces through the use of one or more of the following techniques:				
		NOTE: For lots in a development, the points for 503.4 may be awarded for the lot when there is a community storm water management plan implemented and the builder does not violate that plan with respect to water leaving the lot.				
	(1)	A site assessment is conducted and a plan prepared and implemented that identifies important existing permeable soils, natural drainage ways and other water features, e.g., depressional storage, onsite to be preserved in order to maintain site hydrology.	**7**	7	☑	need soils engineer report
	(2)	A hydrologic analysis is conducted that results in the design of a stormwater management system that maintains the pre-development (stable, natural) runoff hydrology of the site through the development or redevelopment process. Ensure that post construction runoff rate, volume and duration do not exceed predevelopment rates, volume and duration.	**10**	0	☐	
	(3)	Low Impact Development/Green infrastructure stormwater management practices to promote infiltration and evapotranspiration are used to manage rainfall on the lot and prevent the off-lot discharge of runoff from all storms up to and including the volume of following storm events:		0		
	(a)	80th percentile storm event	**5**			
	(b)	90th percentile storm event	**8**			
	(c)	95th percentile storm event	**10**			
	(4)	Permeable materials are used for driveways, parking areas, walkways, patios, and recreational surfaces and the like according to the following percentages:		0		
	(a)	10 percent to less than 25 percent (add 2 points for use of vegetative paving system)	**5**			
	(b)	25-50 percent (add 4 points for use of vegetative paving system)	**8**			
	(c)	Greater than 50 percent (add 6 points for use of vegetative paving system)	**10**			
		[Points for vegetative paving systems are only awarded for locations receiving more than 20 inches per year of annual average precipitation]	**0**	0	☐	
	(5)	Complete gutter and downspout system directs storm water away from foundation to vegetated landscape area, a raingarden, or catchment system that provides for water infiltration.	**3**	3	☑	
503.5		**503.5 Landscape plan.** A plan for the lot is developed to limit water and energy use while preserving or enhancing the natural environment.				
		(Where "front" only or "rear" only plan is implemented, only half of the points (rounding down to a whole number) are awarded for Items (1)-(9))			full	
	(1)	A plan is formulated and implemented that protects, restores, or enhances natural vegetation on the lot.		0		
	(a)	100 percent of the natural area	**4**			
	(b)	50 percent of the natural area	**3**			
	(c)	25 percent of the natural area	**2**			
	(d)	12 percent of the natural area	**1**			
	(2)	Non-invasive vegetation that is native or regionally appropriate for local growing conditions is selected to promote biodiversity.	**7**	0	☐	
	(3)	To improve pollinator habitat, at least 10 percent of planted areas are composed of native or regionally appropriate flowering and nectar producing plant species. Invasive plant species shall not be utilized.	**3**	0	☐	
	(4)	EPA WaterSense Water Budget Tool or equivalent is used when implementing the site vegetative design.	**5**	0	☐	
	(5)	Where turf is being planted, Turfgrass Water Conservation Alliance (TWCA) or equivalent as determined by the adopting entity third party qualified water efficient grasses are used.	**3**	0	☐	
	(6)	For landscaped vegetated areas, the maximum percentage of turf area is:		0		
	(a)	0 percent	**5**			
	(b)	Greater than 0 percent to less than 20 percent	**4**			
	(c)	20 percent to less than 40 percent	**3**			
	(d)	40 percent to 60 percent	**2**			
	(7)	Plants with similar watering needs are grouped (hydrozoning) and shown on the lot plan.	**5**	5	☑	
	(8)	Summer shading by planting installed to shade a minimum of 30 percent of building walls. To conform to summer shading, the effective shade coverage (five years after planting) is the arithmetic mean of the shade coverage calculated at 10 am for eastward facing walls, noon for southward facing walls, and 3 pm for westward facing walls on the summer solstice.	**5**	0	☐	
	(9)	Vegetative wind breaks or channels are designed to protect the lot and immediate surrounding lots as appropriate for local conditions.	**5**	0	☐	
	(10)	Site or community generated tree trimmings or stump grinding of regionally appropriate trees are used on the lot to provide protective mulch during construction or for landscaping.	**3**	0	☐	
	(11)	An integrated pest management plan is developed to minimize chemical use in pesticides and fertilizers.	**4**	0	☐	
	(12)	Developer has a plan for removal or containment of invasive plants from the disturbed areas of the site.	**3**	0	☐	
	(13)	Developer implements a plan for removal or containment of invasive plants on the undisturbed areas of the site.	**6**	0	☐	
503.6		**503.6 Wildlife habitat.** Measures are planned to support wildlife habitat and include at least two of the following:		0		
	(1)	Plants and gardens that encourage wildlife, such as bird and butterfly gardens.	**3**		☐	
	(2)	Inclusion of a certified "backyard wildlife" program.	**3**		☐	
	(3)	The lot is adjacent to a wildlife corridor, fish and game park, or preserved areas and is designed with regard for this relationship.	**3**		☐	
	(4)	Outdoor lighting techniques are utilized with regard for wildlife.	**3**		☐	
503.7		**503.7 Environmentally sensitive areas.** The lot is in accordance with one or both of the following:		4	(1)	
	(1)	The lot does not contain any environmentally sensitive areas that are disturbed by the construction.	**4**			
	(2)	On lots with environmentally sensitive areas, mitigation and/or restoration is conducted to preserve ecosystem functions lost through development and construction activities.	**4**			
503.8		**503.8 Demolition of existing building.** A demolition waste management plan is developed, posted at the jobsite, and implemented to recycle and/or salvage with a goal of recycling or salvaging a minimum of 50 percent of the nonhazardous demolition waste.	**5**	0	☐	
		(One additional point awarded for every 10 percent of nonhazardous demolition waste recycled and/or salvaged beyond 50 percent).	**1 additional**			

504 LOT CONSTRUCTION

504.0		**504.0 Intent.** Environmental impact during construction is avoided to the extent possible; impacts that do occur are minimized and any significant impacts are mitigated.				
504.1		**504.1 On-site supervision and coordination.** On-site supervision and coordination is provided during on-the-lot clearing, grading, trenching, paving, and installation of utilities to ensure that specified green development practices are implemented. (also see Section 503.3) NOTE: Points must be taken in 503.3 to claim points in 504.1.	**4**	4	☑	
504.2		**504.2 Trees and vegetation.** Designated trees and vegetation are preserved by one or more of the following:				
	(1)	Fencing or equivalent is installed to protect trees and other vegetation.	**3**	0	☐	
	(2)	Trenching, significant changes in grade, and compaction of soil and critical root zones in all "tree save" areas as shown on the lot plan are avoided.	**5**	0	☐	
	(3)	Damage to designated existing trees and vegetation is mitigated during construction through pruning, root pruning, fertilizing, and watering.	**4**	0	☐	
504.3		**504.3 Soil disturbance and erosion implementation.** On-site soil disturbance and erosion are minimized by one or more of the following in accordance with the SWPPP or applicable plan: (also see Section 503.3)				
	(1)	Sediment and erosion controls are installed on the lot and maintained in accordance with the stormwater pollution prevention plan, where required.	**5**	5	☑	
	(2)	Limits of clearing and grading are staked out on the lot.	**5**	5	☑	
	(3)	"No disturbance" zones are created using fencing or flagging to protect vegetation and sensitive areas on the lot from construction activity.	**5**	0	☐	
	(4)	Topsoil from either the lot or the site development is stockpiled and stabilized for later use and used to establish landscape plantings on the lot.	**5**	0	☐	
	(5)	Soil compaction from construction equipment is reduced by distributing the weight of the equipment over a larger area (laying lightweight geogrids, mulch, chipped wood, plywood, OSB, metal plates, or other materials capable of weight distribution in the pathway of the equipment).	**4**	0	☐	
	(6)	Disturbed areas on the lot that are complete or to be left unworked for 21 days or more are stabilized within 14 days using methods as recommended by the EPA or in the approved SWPPP, where required.	**3**	3	☑	
	(7)	Soil is improved with organic amendments or mulch.	**3**	0	☐	
	(8)	Utilities on the lot are installed using one or more alternative means: tunneling instead of trenching, use of smaller equipment, use of low ground pressure equipment, use of geomats, shared utility trenches or easements, other. NOTE: List "other" means of installing utilities in the assigned Notes area.	**5**	5	☐ ☐ ☐ ☐ ☑ ☐	
	(9)	Inspection reports of stormwater best management practices are available.	**3**	0	☐	

505 INNOVATIVE PRACTICES

505.0		**505.0 Intent.** Innovative lot design, preparation, and development practices are used to enhance environmental performance. Waivers or variances from local development regulations are obtained and innovative zoning is used to implement such practices.				
505.1		**505.1 Driveways and parking areas.** Driveways and parking areas are minimized or mitigated by one or more of the following:				
	(1)	Off-street parking areas are shared or driveways are shared. Waivers or variances from local development regulations are obtained to implement such practices, if required.	**5**	5	☑	
	(2)	In a multifamily project, parking capacity does not exceed the local minimum requirements.	**5**	0	☐	
	(3)	Structured parking is utilized to reduce the footprint of surface parking areas.		0		
	(a)	25 percent to less than 50 percent	**4**			
	(b)	50 percent to 75 percent	**5**			
	(c)	greater than 75 percent	**6**			
505.2		**505.2 Heat island mitigation.** Heat island effect is mitigated by the following.				
	(1)	Hardscape: Not less than 50 percent of the surface area of the hardscape on the lot meets one or a combination of the following methods.	**5**	0		
	(a)	Shading of hardscaping: Shade is provided from existing or new vegetation (within five years) or from trellises. Shade of hardscaping is to be measured on the summer solstice at noon.			☐	
	(b)	Light-colored hardscaping: Horizontal hardscaping materials are installed with a solar reflectance index (SRI) of 29 or greater. The SRI is calculated in accordance with ASTM E1980. A default SRI value of 35 for new concrete without added color pigment is permitted to be used instead of measurements.			☐	
	(c)	Permeable hardscaping: Permeable hardscaping materials are installed.			☐	
	(2)	Roofs: Not less than 75 percent of the exposed surface of the roof is vegetated using technology capable of withstanding the climate conditions of the jurisdiction and the microclimate conditions of the building lot. Invasive plant species are not permitted.	**5**	0	☐	
505.3		**505.3 Density.** The average density on the lot on a net developable area basis is:		5	(2)	154 units on 7.5 Ac = 20 units/Ac
	(1)	7 to less than 14 dwelling units/sleeping units per acre (per 4,047 m2)	**4**			
	(2)	14 to less than 21 dwelling units/sleeping units per acre (per 4,047 m2)	**5**			
	(3)	21 to less than 35 dwelling units/sleeping units per acre (per 4,047 m2)	**6**			
	(4)	35 to less than 70 dwelling units/sleeping units per acre (per 4,047 m2)	**7**			
	(5)	70 or greater dwelling units/sleeping units per acre (per 4,047 m2)	**8**			
505.4		**505.4 Mixed-use development.**				
	(1)	The lot contains a mixed-use building.	**8**	0	☐	
505.5		**505.5 Multifamily & mixed-use community garden(s).** A portion of the lot is established as a community garden(s), available to residents of the lot, to provide for local food production to residents or area consumers.			Community Garden (sf):	
	(a)	A portion of the lot of at least 250 sq ft is established as community garden(s) for the residents of the site. [*3 points per 250 sq ft]	**9 max**	0		
	(b)	Locate the project within a 0.5-mile walking distance of an existing or planned farmers market/ farm stand that is open or will operate at least once a week for at least five months of the year.	**3**	0	☐	
	(c)	Areas and physical provisions are provided for composting.	**1**	0	☐	
	(d)	Signs designating the garden area are posted.	**1**	0	☐	
505.6		**505.6 Multi-Unit Plug-In Electric Vehicle Charging.** Plug-in electric vehicle charging capability is provided for not fewer than 2 percent of parking stalls. [An additional 2 points can be earned for each percentage point above 2% for a maximum of 10 points] Fractional values shall be rounded up to the nearest whole number. Electrical capacity in main electric panels supports Level 2 charging (208/240V- up to 80 amps or in accordance with SAE J1772). Each stall is provided with conduit and wiring infrastructure from the electric panel to support Level 2 charging (208/240V- up to 80 amps or in accordance with SAE J1772) service to the designated stalls, and stalls are equipped with either Level 2 charging AC grounded outlets (208/240V- up to 80 amps or in accordance with SAE J1772) or Level 2 charging stations (208/240V- up to 80 amps or in accordance with SAE J1772) by a third party charging station. NOTE: SF/BTR homes are also eligible if 2% or more of the total of shared/communal/visitor parking stalls in the development/community have plug-in electric vehicle charging capability.	**4 (10 max)**	0		Will EV charging Stations be installed

505.7		**505.7 Multi-unit residential CNG vehicle fueling.** CNG vehicle residential fueling appliances are provided for at least 1 percent of the parking stalls. The CNG fueling appliances shall be listed in accordance with ANSI/CSA NGV 5.1 and installed in accordance with the appliance manufacturer's installation instructions. NOTE: Single-Family/Build-to-Rent homes are also eligible if 1% of the shared/communal/visitor parking stalls in the development have residential CNG vehicle refueling.	**4**	0	☐	
505.8		**505.8 Street network.** Locate the project in an area of high intersection density.	**5**	0	☐	
505.9		**505.9 Smoking prohibitions.** Signs are provided on multifamily and mixed-use lots prohibiting smoking at the following locations: NOTE: Build-to-rent homes are also eligible for (a), (b) and (c) if smoking is prohibited and signs posted for all homes in the development/community. SF homes for sale are not eligible.			Build-to-Rent? ☐	
	(a)	Smoking is prohibited within 25 feet (7.5 m) of all building exterior doors and operable windows or building air intakes within 15 (4.5 m) vertical feet of grade or a walking surface.	**3**	0	☐	
	(b)	Smoking is prohibited on decks, balconies, patios and other occupied exterior spaces.	**3**	0	☐	
	(c)	Smoking is prohibited at all parks, playgrounds, and community activity or recreational spaces.	**3**	0	☐	
505.10		**505.10 Exercise & Recreation Area.** For multifamily buildings, on-site dedicated recreation space for exercise or play opportunities for adults and/or children open and accessible to residents is provided.				
	(a)	A dedicated area of at least 400 square feet is provided inside the building with adult exercise and/or children's play equipment.	**3**	0	☐	
	(b)	A courtyard, garden, terrace, or roof space at least 10% of the lot area that can serve as outdoor space for children's play and /or adult activities is provided.	**3**	0	☐	
	(c)	Active play/recreation areas are illuminated at night to extend opportunities for physical activity into the evening.	**3**	0	☐	
END OF CHAPTER 5						CLICK TO PROCEED TO CHAPTER 6 >>

	Current Chapter level: Silver	**Total Points: 84**				
	Points away from: Bronze: 0, Silver: 0, Gold: 5, Emerald: 35					
	Add'l pts earned above: Bronze: 41, Silver: 25, Gold: 0, Emerald: 0					
	Total Chapter Points needed for: Bronze: 43, Silver: 59, Gold: 89, Emerald: 119					
	Revision Date: 2/28/2024					

NGBS GREEN
Home Innovation Research Labs

Coding

Practice #		Chapter 6: Resource Efficiency	Points Available	Points Claimed	Status	Notes
601 QUALITY OF CONSTRUCTION MATERIALS AND WASTE						
601.0		**601.0 Intent.** Design and construction practices that minimize the environmental impact of the building materials are incorporated, environmentally efficient building systems and materials are incorporated, and waste generated during construction is reduced.				
601.1		**601.1 Conditioned floor area.** Finished floor area of a dwelling unit or sleeping unit is limited. Finished floor area is calculated in accordance with ANSI Z765 for single family and ANSI/BOMA Z65.4 for multifamily buildings. Only the finished floor area for stories above grade plane is included in the calculation. [For every 100 square feet (9.29 m2) over 4,000 square feet (372 m2), one point is to be added to rating level points shown in Table 303, Category 7 for each rating level.]		12		
	(1)	less than or equal to 700 square feet (65 m^2)	**14**			
	(2)	less than or equal to 1,000 square feet (93 m^2)	**12**			
	(3)	less than or equal to 1,500 square feet (139 m^2)	**9**			
	(4)	less than or equal to 2,000 square feet (186 m^2)	**6**			
	(5)	less than or equal to 2,500 square feet (232 m^2)	**3**			
	(6)	greater than 4,000 square feet (372 m^2)	**N/A**			
		(For every 100 square feet (9.29 m^2) over 4,000 square feet (372 m^2), one point is to be added to rating level points shown in Table 303, Category 7 for each rating level.)				
		Multifamily Building Note: For a multifamily building, a weighted average of the individual unit sizes is used for this practice.				
601.2		**601.2 Material usage.** Structural systems are designed or construction techniques are implemented that reduce and optimize material usage.				
	(1)	Minimum structural member or element sizes necessary for strength and stiffness in accordance with advanced framing techniques or structural design standards are selected.	**3**	3	☑	Trusses
	(2)	Higher-grade or higher-strength of the same materials than commonly specified for structural elements and components in the building are used and element or component sizes are reduced accordingly.	**3**	3	☑	Engineered wood
	(3)	Performance-based structural design is used to optimize lateral force-resisting systems.	**3**	3	☑	Shear walls
601.3		**601.3 Building dimensions and layouts.** Building dimensions and layouts are designed to reduce material cuts and waste. This practice is used for a minimum of 80 percent of the following areas:				
	(1)	floor area	**3**	0	☐	
	(2)	wall area	**3**	0	☐	
	(3)	roof area	**3**	0	☐	
	(4)	cladding or siding area	**3**	0	☐	
	(5)	penetrations or trim area	**1**	0	☐	
601.4		**601.4 Framing and structural plans.** Detailed framing or structural plans, material quantity lists and on-site cut lists for framing, structural materials, and sheathing materials are provided.	**4**	0	☐	
601.5		**601.5 Prefabricated components.** Precut or preassembled components, or panelized or precast assemblies are utilized for a minimum of 90 percent for the following system or building:	**13 Max**			
	(1)	floor system	**4**	4	☑	Trusses
	(2)	wall system	**4**	0	☐	
	(3)	roof system	**4**	4	☑	Trusses
	(4)	modular construction for the entire building located above grade	**13**	0	☐	
	(5)	manufactured home construction for the entire building located above grade	**13**	0	☐	
601.6		**601.6 Stacked stories.** Stories above grade are stacked, such as in 1½-story, 2-story, or greater structures. The area of the upper story is a minimum of 50 percent of the area of the story below based on areas with a minimum ceiling height of 7 feet (2,134 mm).	**8 Max**	6	from overview: 3 story bldg.	
	(1)	first stacked story	**4**			
	(2)	for each additional stacked story	**2**			
601.7		**601.7 Prefinished materials. Prefinished building** materials or assemblies listed below have no additional site-applied finishing material are installed.	**12 Max**	12		Windows, siding, flooring, cabinets
		(Points awarded for each type of material or assembly.)				
	(a)	interior trim not requiring paint or stain				
	(b)	exterior trim not requiring paint or stain				
	(c)	window, skylight, and door assemblies not requiring paint or stain on one of the following surfaces: i. exterior surfaces ii. interior surfaces			90% or more	
	(d)	interior wall coverings or systems, floor systems, and/or ceiling systems not requiring paint or stain or other type of finishing application			50% to less than 90%	
	(e)	exterior wall coverings or systems, floor system, and/or ceiling systems not requiring paint or stain or other type of finishing application			90% or more	
	(1)	90 percent or more of the installed building materials or assemblies listed above:	**5**			
	(2)	50 percent to less than 90 percent of the installed building material or assembly listed above:	**2**			
	(3)	35 percent to less than 50 percent of the installed building material or assembly listed above:	**1**			
601.8		**601.8 Foundations.** A foundation system that minimizes soil disturbance, excavation quantities, and material usage, such as frost-protected shallow foundations, isolated pier and pad foundations, deep foundations, post foundations, or helical piles is selected, designed, and constructed. The foundation is used on 50 percent or more of the building footprint.	**3**	0	☐	
		NOTE: Indicate in the assigned Notes area the type designed and constructed: frost-protected shallow foundations, pier and pad foundations, post foundations, or other similar foundation type.				

602 ENHANCED DURABILITY AND REDUCED MAINTENANCE

602.0		**602.0 Intent.** Design and construction practices are implemented that enhance the durability of materials and reduce in-service maintenance.				
602.1		**602.1 Moisture Management – Building Envelope**				
602.1.1		**602.1.1 Capillary breaks**				
602.1.1.1		**602.1.1.1** A capillary break and vapor retarder are installed at concrete slabs in accordance with ICC IRC Sections R506.2.2 and R506.2.3 or ICC IBC Sections 1907 and 1805.4.1.	Mandatory		Met	
602.1.1.2		**602.1.1.2** A capillary break between the footing and the foundation wall is provided to prevent moisture migration into foundation wall.	3	0	☐	
602.1.2		**602.1.2 Foundation waterproofing.** Enhanced foundation waterproofing is installed using one or both of the following:	4	0		
	(1)	rubberized coating, or			☐	
	(2)	drainage mat			☐	
602.1.3		**602.1.3 Foundation drainage**				
602.1.3.1		**602.1.3.1** Where required by the ICC IRC or IBC for habitable and usable spaces below grade, exterior drain tile is installed.	N/A		☐	
602.1.3.2		**602.1.3.2** Interior and exterior foundation perimeter drains are installed and sloped to discharge to daylight, dry well, or sump pit.	4	0	☐	
602.1.4		**602.1.4 Crawlspaces**				
602.1.4.1		**602.1.4.1** Vapor retarder in unconditioned vented crawlspace is in accordance with the following, as applicable. Joints of vapor retarder overlap a minimum of 6 inches (152 mm) and are taped.				
	(1)	Floors. Minimum 6 mil vapor retarder installed on the crawlspace floor and extended at least 6 inches up the wall and is attached and sealed to the wall.	6	0	☐	
	(2)	Walls. Dampproof walls are provided below finished grade.	N/A			
602.1.4.2		**602.1.4.2** Crawlspace that is built as a conditioned area is sealed to prevent outside air infiltration and provided with conditioned air at a rate not less than 0.02 cfm (.009 L/s) per square foot of horizontal area and one of the following is implemented:				
	(1)	a concrete slab over 6 mil polyethylene sheeting. Or other Class I vapor retarder installed in accordance with Section 408.3 or Section 506 of the International Residential Code	8	0	☐	
	(2)	6 mil polyethylene sheeting, or other Class I vapor retarder installed in accordance with Section 408.3 or Section 506 of the International Residential Code	N/A			
602.1.5		**602.1.5 Termite barrier.** Continuous physical foundation termite barrier provided: See Figure 6(3)			termite infest. prob.:	
	(1)	In geographic areas that have moderate to heavy infestation potential in accordance with figure 6(3), a no or low toxicity treatment is also installed.	4	0	☐	
	(2)	In geographic areas that have a very heavy infestation potential in accordance with figure 6(3), in addition a low toxicity bait and kill termite treatment plan is selected and implemented.	4	0	☐	
602.1.6		**602.1.6 Termite-resistant materials.** In areas of termite infestation probability as defined by Figure 6(3), termite-resistant materials are used as follows: See Figure 6(3)				
	(1)	In areas of slight to moderate termite infestation probability: for the foundation, all structural walls, floors, concealed roof spaces not accessible for inspection, exterior decks, and exterior claddings within the first 2 feet (610 mm) above the top of the foundation.	2	0	☐	
	(2)	In areas of moderate to heavy termite infestation probability: for the foundation, all structural walls, floors, concealed roof spaces not accessible for inspection, exterior decks, and exterior claddings within the first 3 feet (914 mm) above the top of the foundation.	4	0	☐	
	(3)	In areas of very heavy termite infestation probability: for the foundation, all structural walls, floors, concealed roof spaces not accessible for inspection, exterior decks, and exterior claddings.	6	0	☐	
602.1.7		**602.1.7 Moisture control measures**				
602.1.7.1		**602.1.7.1** Moisture control measures are in accordance with the following:				
	(1)	Building materials with visible mold are not installed or are cleaned or encapsulated prior to concealment and closing.	2	2	☑	
	(2)	Insulation in cavities is dry in accordance with manufacturer's instructions when enclosed (e.g., with drywall). NOTE: if "N/A" is selected, explain why in the assigned Notes area.	Mandatory 2	2	Met	
	(3)	The moisture content of lumber is sampled to ensure it does not exceed 19 percent prior to the surface and/or cavity enclosure.	4	4	☑	
602.1.7.2		**602.1.7.2** Moisture content of subfloor, substrate, or concrete slabs is in accordance with the appropriate industry standard for the finish flooring to be applied.	2	2	☑	OSB floors
602.1.7.3		**602.1.7.3** Building envelope assemblies are designed for moisture control based on documented hygrothermal simulation or field study analysis. Hygrothermal analysis is required to incorporate representative climatic conditions, interior conditions and include heating and cooling seasonal variation.	4	0	☐	
602.1.8		**602.1.8 Water-resistive barrier.** Where required by the ICC, IRC, or IBC, a water-resistive barrier and/or drainage plane system is installed behind exterior veneer and/or siding. NOTE: If "N/A" is selected, explain why in the assigned Notes area.	Mandatory		Met	
602.1.9		**602.1.9 Flashing.** Flashing is provided as follows to minimize water entry into wall and roof assemblies and to direct water to exterior surfaces or exterior water-resistive barriers for drainage. Flashing details are provided in the construction documents and are in accordance with the fenestration manufacturer's instructions, the flashing manufacturer's instructions, or as detailed by a registered design professional.				
	(1)	Flashing is installed at all of the following locations, as applicable:	Mandatory		☑	
	(a)	around exterior fenestrations, skylights, and doors				
	(b)	at roof valleys				
	(c)	at all building-to-deck, -balcony, -porch, and -stair intersections				
	(d)	at roof-to-wall intersections, at roof-to-chimney intersections, at wall-to-chimney intersections, and at parapets				
	(e)	at ends of and under masonry, wood, or metal copings and sills				
	(f)	above projecting wood trim				
	(g)	at built-in roof gutters, and				
	(h)	drip edge is installed at eave and rake edges.				
	(2)	All window and door head and jamb flashing is either self-adhered flashing complying with AAMA 711-13 or liquid applied flashing complying with AAMA 714-15 and installed in accordance with fenestration or flashing manufacturer's installation instructions.	2	2	☑	
	(3)	Pan flashing is installed at sills of all exterior windows and doors.	3	3	☑	
	(4)	Seamless, preformed kickout flashing, or prefabricated metal with soldered seams is provided at all roof-to-wall intersections. The type and thickness of the material used for roof flashing including but not limited kickout and step flashing is commensurate with the anticipated service life of the roofing material.	3	0	☐	
	(5)	A rainscreen wall design as follows is used for exterior wall assemblies		0		
	(a)	a system designed with minimum 1/4-inch air space exterior to the water-resistive barrier, vented to the exterior at top and bottom of the wall, and integrated with flashing details. OR	4			
	(b)	a cladding material or a water-resistive barrier with enhanced drainage, meeting 75 percent drainage efficiency determined in accordance with ASTM E2273.	2			
	(6)	Through-wall flashing is installed at transitions between wall cladding materials or wall construction types.	2	2	☑	
	(7)	Flashing is installed at expansion joints in stucco walls.	2	0	☐	

602.1.10		**602.1.10 Exterior doors.** Entries at exterior door assemblies, inclusive of side lights (if any), are covered by one of the following methods to protect the building from the effects of precipitation and solar radiation. Either a storm door or a projection factor of 0.375 minimum is provided. Eastern- and western-facing entries in Climate Zones 1, 2, and 3, as determined in accordance with Figure 6(1) or Appendix A, have either a storm door or a projection factor of 1.0 minimum, unless protected from direct solar radiation by other means (e.g., screen wall, [illegible]). This Project's Climate Zone: 4	**2 per exterior door 6 Max**	0		
	(a)	installing a porch roof or awning				
	(b)	extending the roof overhang				
	(c)	recessing the exterior door				
	(d)	Installing a storm door				
		Note: The pedestrian door protected in a garage leading to living space does not qualify for points.				
602.1.11		**602.1.11 Tile backing materials.** Tile backing materials installed under tiled surfaces in wet areas are in accordance with ASTM C1178, C1278, C1288, or C1325.	**Mandatory**		Met	
602.1.12		**602.1.12 Roof overhangs.** Roof overhangs, in accordance with Table 602.1.12, are provided over a minimum of 90 percent of exterior walls to protect the building envelope. See Table 602.1.12	**4**	0	☐	
602.1.13		**602.1.13 Ice barrier.** In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier is installed in accordance with the ICC IRC or IBC at roof eaves of pitched roofs and extends a minimum of 24 inches (610 mm) inside the exterior wall line of the building.	**Mandatory**		Met	
602.1.14		**602.1.14 Architectural features**. Architectural features that increase the potential for water intrusion are avoided:				
	(1)	All horizontal ledgers are sloped away to provide gravity drainage as appropriate for the application.	**Mandatory 1**	1	Met	
	(2)	No roof configurations that create horizontal valleys in roof design.	**2**	2	☑	
	(3)	No recessed windows and architectural features that trap water on horizontal surfaces.	**2**	2	☑	
602.1.15		**602.1.15 Kitchen and vanity cabinets.** All kitchen and vanity cabinets are certified in accordance with the ANSI/KCMA A161.1 performance standard or equivalent. NOTE: Identify what product was used in the assigned Notes area.	**2**	0	☐	
602.2		**602.2 Roof surfaces.** A minimum of 90 percent of roof surfaces, not used for roof penetrations and associated equipment, on-site renewable energy systems such as photovoltaics or solar thermal energy collectors, or rooftop decks, amenities and walkways, are constructed of one or more of the following:	**3**	0		
	(1)	products that are in accordance with the ENERGY STAR® cool roof certification or equivalent			☐	
	(2)	a vegetated roof system			☐	
	(3)	Minimum initial SRI of 78 for low-sloped roof (a slope less than 2:12) and a minimum initial SRI of 29 for a steep-sloped roof (a slope equal to or greater than 2:12). The SRI is calculated in accordance with ASTM E1980. Roof products are certified and labeled.			☐	
602.3		**602.3 Roof water discharge.** A gutter and downspout system or splash blocks and effective grading are provided to carry water a minimum of 5 feet (1524 mm) away from perimeter foundation walls.	**4**	4	☑	
602.4		**602.4 Finished grade.**				
602.4.1		**602.4.1** Finished grade at all sides of a building is sloped to provide a minimum of 6 inches (150 mm) of fall within 10 feet (3048 mm) of the edge of the building. Where lot lines, walls, slopes, or other physical barriers prohibit 6 inches (152 mm) of fall within 10 feet (3048 mm), the final grade is sloped away from the edge of the building at a minimum slope of 2 percent.	**Mandatory**		☑	
602.4.2		**602.4.2** The final grade is sloped away from the edge of the building at a minimum slope of 5 percent.	**1**	0	☐	
602.4.3		**602.4.3** Water is directed to drains or swales to ensure drainage away from the structure.	**1**	1	☑	
603 REUSED OR SALVAGED MATERIALS						
603.0		**603.0 Intent.** Practices that reuse or modify existing structures, salvage materials for other uses, or use salvaged materials in the building's construction are implemented.				
603.1		**603.1 Reuse of existing building.** Major elements or components of existing buildings and structures are reused, modified, or deconstructed for later use. **(Points awarded for every 200 square feet (18.5 m^2) of floor area.)** NOTE: Describe materials used in the assigned Notes area. Materials, elements, or components awarded points under Section 603.1 shall not be awarded points under Section 603.2.	**1 12 Max**	0		
603.2		**603.2 Salvaged materials.** Reclaimed and/or salvaged materials and components are used. The total material value and labor cost of salvaged materials is equal to or exceeds 1 percent of the total construction cost. **(Points awarded per 1% of salvaged materials used based on the total construction cost.)** NOTE: Describe materials used in the assigned Notes area. Materials, elements, or components awarded points under Section 603.1 shall not be awarded points under Section 603.2.	**1 9 Max**	0		
603.3		**603.3 Scrap materials.** Sorting and reuse of scrap building material is facilitated (e.g., a central storage area or dedicated bins are provided). NOTE: Indicate in the assigned Notes area what salvage materials were sorted for reuse.	**4**	0	☐	
604 RECYCLED-CONTENT BUILDING MATERIALS						
604.1		**604.1 Recycled content.** Building materials with recycled content are used for two minor and/or two major components of the building. Enter material percent recycled content. See Table 604.1 NOTE: In the assigned Notes area, list materials used for minor and/or major building components.	**per Table 604.1**	3	First Minor Comp.: Steel 80.0% Second Minor Comp.: AL 80.0% First Major Comp.: Second Major Comp.:	
605 RECYCLED CONSTRUCTION WASTE						
605.0		**605.0 Intent.** Waste generated during construction is recycled.				
605.1		**605.1 Hazardous waste.** The construction and waste management plan shall include information on the proper handling and disposal of hazardous waste. Hazardous waste is properly handled and disposed.	**Mandatory**		☑	
605.2		**605.2 Construction waste management plan.** A construction waste management plan is developed, posted at the jobsite, and implemented diverting, through reuse, salvage, recycling, or manufacturer reclamation, a minimum of 50 percent (by weight) of nonhazardous construction and demolition waste from disposal. For this practice, land clearing debris is not considered construction waste. Materials used as alternative daily cover are considered construction waste and do not count toward recycling or salvaging. For buildings following the new construction path that also have a renovation component, the waste management plan includes the recycling of 95 percent of electronic waste components (such as printed circuit boards from computers, building automation systems, HVAC, fire and security control boards) by an E-Waste recycling facility. **Exceptions:**	**6**	0	☐	
	(1)	Waste materials generated from land clearing, soil and sub-grade excavation and vegetative debris shall not be in the calculations.				
	(2)	A recycling facility (traditional or E-Waste) offering material receipt documentation is not available within 50 miles of the jobsite.			☐	

605.3		**605.3 On-site recycling.** On-site recycling measures following applicable regulations and codes are implemented, such as the following:	7	0	☐	
	(a)	Materials are ground or otherwise safely applied on-site as soil amendment or fill. A minimum of 50 percent (by weight) of construction and land-clearing waste is diverted from landfill.				
	(b)	Alternative compliance methods approved by the Adopting Entity.				
	(c)	Compatible untreated biomass material (lumber, posts, beams, etc.) are set aside for combustion if a solid fuel-burning appliance per Section 901.2.1(2) will be available for on-site renewable energy.				
605.4		**605.4 Recycled construction materials.** Construction materials (e.g., wood, cardboard, metals, drywall, plastic, asphalt roofing shingles, or concrete) are recycled offsite.	**6 Max**	0		
	(1)	a minimum of two types of materials are recycled	**3**			
	(2)	for each additional recycled material type	**1**			
	(a)	wood			☐	
	(b)	cardboard			☐	
	(c)	metals			☐	
	(d)	drywall			☐	
	(e)	plastic			☐	
	(f)	asphalt roofing shingles			☐	
	(g)	concrete			☐	
	(h)	other			☐	
	(i)	other			☐	
		NOTE: List "other" types of materials recycled in the assigned Notes area.				

606 RENEWABLE MATERIALS

606.0		**606.0 Intent.** Building materials derived from renewable resources are used.				
606.1		**606.1 Biobased products.** The following biobased products are used:				
	(a)	certified solid wood in accordance with Section 606.2				
	(b)	engineered wood				
	(c)	bamboo				
	(d)	cotton				
	(e)	cork		0		
	(f)	straw				
	(g)	natural fiber products made from crops (soy-based, corn-based)				
	(h)	other biobased materials with a minimum of 50 percent biobased content (by weight or volume)				
		Note: Please list "other biobased materials" used in the Notes field				
	(1)	Two types of biobased materials are used, each for more than 0.5 percent of the project's projected building material cost.	**3**			
	(2)	Two types of biobased materials are used, each for more than 1 percent of the project's projected building material cost.	**6**			
	(3)	For each additional biobased material used for more than 0.5 percent of the project's projected building material cost.	**1** **2 Max**			
606.2		**606.2 Wood-based products.** Wood or wood-based products are certified to the requirements of one of the following:				
	(a)	American Forest Foundation's *American Tree Farm System®* (ATFS)				
	(b)	Canadian Standards Association's *Sustainable Forest Management System Standards* (CSA Z809)				
	(c)	*Forest Stewardship Council* (FSC)				
	(d)	*Program for Endorsement of Forest Certification Systems* (PEFC)				
	(e)	*Sustainable Forestry Initiative ® Program (SFI)*				
	(f)	National Wood Flooring Association's Responsible Procurement Program (RPP)				
	(g)	other product programs mutually recognized by PEFC				
	(h)	A manufacturer's fiber procurement system that has been audited by an approved agency as compliant with the provisions of ASTM D7612 as a responsible or certified source. Government or tribal forestlands whose water protection programs have been evaluated by an approved agency as compliant with the responsible source designation of ASTM D7612 are exempt from auditing in the manufacturers' fiber procurement system.			Program(s):	
	(1)	A minimum of two responsible or certified wood-based products are used for minor components of the building.	**3**	0		
		Note: Please list products and components in the Notes fields				
	(2)	A minimum of two responsible or certified wood-based products are used in major components of the building.	**4**	0		
		Note: Please list products and components in the Notes fields				
606.3		**606.3 Manufacturing energy.** Materials manufactured using a minimum of 33 percent of the primary manufacturing process energy derived from (1) renewable sources, (2) combustible waste sources, or (3) renewable energy credits (RECs) are used for major components of the building. **(2 points awarded per material.)**	**6 Max**	0		
		Note: Please list materials in the Notes field				

607 RECYCLING AND WASTE REDUCTION

607.1		**607.1 Recycling and composting.** Recycling and composting by the occupant are facilitated by one or more of the following methods:				
	(1)	A readily accessible space(s) for recyclable material containers is provided and identified on the floorplan of the house or dwelling unit or a readily accessible area(s) outside the living space is provided for recyclable material containers and identified on the site plan for the house or building. The area outside the living space shall accommodate recycling bin(s) for recyclable materials accepted in local recycling programs.	**2**	0	☐	
	(2)	A readily accessible space(s) for compostable material containers is provided and identified on the floorplan of the house or dwelling unit or a readily accessible area(s) outside the living space is provided for compostable material containers and identified on the site plan for the house or building. The area outside the living space shall accommodate composting container(s) for locally accepted materials, or, accommodate composting container(s) for on-site composting.	**4**	0	☐	
607.2		**607.2 Food waste disposers.** A minimum of one food waste disposer is installed at the primary kitchen sink.	**1**	0	☐	

608 RESOURCE-EFFICIENT MATERIALS

608.1		**608.1 Resource-efficient materials.** Products containing fewer materials are used to achieve the same end-use requirements as conventional products, including but not limited to:				
	(1)	lighter, thinner brick with bed depth less than 3 inches and/or brick with coring of more that 25 percent	**9 Max** **3 per material**	0		
	(2)	engineered wood or engineered steel products				
	(3)	roof or floor trusses				
		NOTE: In the assigned Notes area, describe the types of products that comply with 608.1.				

609 REGIONAL MATERIALS

609.1 **609.1 Regional materials.** Regional materials are used for major and/or minor components of the building. — **10 Max**

# of major components:

(1) Major component — **2 per each component** — 4 — 2 components — Brick & Concrete

# of minor components:

(2) Minor component — **1 per each component**

For a component to comply with this practice, a minimum of 75 percent of all products in that component category must be sourced regionally, e.g., stone veneer category – 75 percent or more of the stone veneer on a project must be sourced regionally.

NOTE: In the assigned Notes areas, list major and minor materials used that comply with 609.1.

610 LIFE CYCLE ASSESSMENT

610.1 **610.1 Life cycle assessment.** A life cycle assessment (LCA) tool is used to select environmentally preferable products, assemblies, or, entire building designs. Points are awarded in accordance with Section 610.1.1 or 610.1.2. Only one method of analysis or tool may be utilized. The reference service life for the building is 60 years for any life cycle analysis tool. Results of the LCA are reported in the manual required in Section 1001.1 or 1002.1(1) of this Standard in terms of the environmental impacts listed in this practice and it is stated if operating energy was included in the LCA.

NOTE: Identify the LCA tool utilized and the person who completed the analysis.

610.1.1 **610.1.1 Whole-building life cycle assessment.** A whole-building LCA is performed in conformance with ASTM E2921 using ISO14044 compliant life cycle assessment.

(1) Execute LCA at the whole building level through a comparative analysis between the final and reference building designs as set forth under Standard Practice, ASTM E2921. The assessment criteria includes the following environmental impact categories:

- **(a)** Primary energy use
- **(b)** Global warming potential
- **(c)** Acidification potential
- **(d)** Eutrophication potential
- **(e)** Ozone depletion potential
- **(f)** Smog potential

8 — 0 — ☐

(2) Execute LCA on regulated loads throughout the building operations life cycle stage. Conduct simulated energy performance analyses in accordance with Section 702.2.1 ICC IECC analysis (IECC Section 405) in establishing the comparative performance of final versus reference building designs. Primary energy use savings and global warming potential avoidance from simulation analyses results are determined using energy supplier, utility, or EPA electricity generation and other fuels energy conversion factors and electricity generation and other fuels emission rates for the locality or Sub-Region in which the building is located — **5** — 0 — ☐

(3) Execute full LCA, including use-phase, through calculation of operating energy impacts (c) – (f) using local or regional emissions factors from energy supplier, utility, or EPA. — **2** — 0 — ☐

610.1.2 **610.1.2 Life cycle assessment for a product or assembly.** An environmentally preferable product or assembly is selected for an application based upon the use of an LCA tool that incorporates data methods compliant with ISO 14044 or other recognized standards that compare the environmental impact of products or assemblies. — **10 Max** — 0

610.1.2.1 **610.1.2.1 Product LCA.** A product with improved environmental impact measures compared to another product(s) intended for the same use is selected. The environmental impact measures used in the assessment are selected from the following:

- **(a)** Primary energy use
- **(b)** Global warming potential
- **(c)** Acidification potential
- **(d)** Eutrophication potential
- **(e)** Ozone depletion potential
- **(f)** Smog potential

(Points are awarded for each product/system comparison where the selected product/system improved upon the environmental impact measures by an average of 15 percent.)

NOTE: List products/systems compared & impact measures considered in the assigned Notes area.

per Table 610.1.2.1 — **10 Max**

# of comparisons with 4 measures:

# of comparisons with 5 measures:

610.1.2.2 **610.1.2.2 Building assembly LCA.** A building assembly with improved environmental impact measures compared to an alternative assembly of the same function is selected. The full life cycle, from resource extraction to demolition and disposal (including but not limited to on-site construction, maintenance and replacement, material and product embodied acquisition, and process and transportation energy), is assessed. The assessment includes all structural elements, insulation, and wall coverings of the assembly. The assessment does not include electrical and mechanical equipment and controls, plumbing products, fire detection and alarm systems, elevators, and conveying systems. The following types of building assemblies are eligible for points under this practice:

- **(a)** exterior walls
- **(b)** roof/ceiling
- **(c)** interior walls or ceilings
- **(d)** intermediate floors

The environmental impact measures used in the assessment are selected from the following:

- **(a)** Primary energy use
- **(b)** Global warming potential
- **(c)** Acidification potential
- **(d)** Eutrophication potential
- **(e)** Ozone depletion potential
- **(f)** Smog potential

(Points are awarded based on the number of types of building assemblies that improve upon environmental impact measures by an average of 15 percent.)

NOTE: List assemblies compared & impact measures considered in the assigned Notes area.

per Table 610.1.2.2 — **10 Max**

exterior walls:

roof/ceiling:

int. walls or ceilings:

intermediate floors:

611 PRODUCT DECLARATIONS

611.1	**611.1 Product declarations.** A minimum of 10 different products installed in the building project, at the time of certificate of occupancy, comply with one of the following sub-sections. Declarations, reports, and assessments are submitted and contain documentation of the critical peer review by an independent third party, results from the review, the reviewer's name, company name, contact information, and date of the review.	**5**	0		
611.1.1	**611.1.1 Industry-wide declaration.** A Type III industry-wide environmental product declaration (EPD) is submitted for each product. Where the program operator explicitly recognizes the EPD as representative of the product group on a National level, it is considered industry-wide. In the case where an industry-wide EPD represents only a subset of an industry group, as opposed to being industry-wide, the manufacturer is required be explicitly recognized as a participant by the EPD program operator. All EPDs are required to be consistent with ISO Standards 14025 and 21930 with at least a cradle-to-gate scope. **(Each product complying with Section 611.1.1 shall be counted as one product for compliance with Section 611.1.)** NOTE: List products in the assigned Notes area.			# of products:	
611.1.2	**611.1.2 Product Specific Declaration.** A product specific Type III EPD are submitted for each product. The product specific declaration shall be manufacturer specific for an individual product or product family. All Type III EPDs are required to be certified as complying, at a minimum, with the goal and scope for the cradle-to-gate requirements in accordance with ISO Standards 14025 and 21930. **(Each product complying with Section 611.1.2 shall be counted as two products for compliance with Section 611.1.)** NOTE: List products in the assigned Notes area.			# of products (not effective number):	

612 INNOVATIVE PRACTICES

612.1	**612.1 Manufacturer's environmental management system concepts.** Product manufacturer's operations and business practices include environmental management system concepts, and the production facility is registered to ISO 14001 or equivalent. The aggregate value of building products from registered ISO 14001 or equivalent production facilities is 1 percent or more of the estimated total building materials cost. **(1 point awarded per percent.)** NOTE: In the assigned Notes area, list products that comply with manufacturers and ISO registrars.	**10 Max**	0		
612.2	**612.2 Sustainable products.** One or more of the following products are used for at least 30% of the floor or wall area of the entire dwelling unit or the sleeping unit, as applicable. Products are certified by a third-party agency accredited to ISO 17065.	**9 Max**	0		
(1)	50% or more of carpet installed (by square feet) is certified to NSF 140 or equivalent.	**3**		☐	
(2)	50% or more of resilient flooring installed (by square feet) is certified to NSF 332 or equivalent.	**3**		☐	
(3)	50% or more of the insulation installed (by square feet) is certified to UL 2985 or equivalent.	**3**		☐	
(4)	50% or more of interior wall coverings installed (by square feet) is certified to NSF 342 or equivalent.	**3**		☐	
(5)	50% or more of the gypsum board installed (by square feet) is certified to UL 100 or equivalent.	**3**		☐	
(6)	50% or more of the door leafs installed (by number of door leafs) is certified to UL 102 or equivalent.	**3**		☐	
(7)	50% or more of the tile installed (by square feet) is certified to TCNA A138.1 Specifications for Sustainable Ceramic Tiles, Glass Tiles and Tile Installation Materials or equivalent.	**3**		☐	
612.3	**612.3 Universal design elements.** Dwelling incorporates one or more of the following universal design elements. Conventional industry construction tolerances are permitted.	**12 Max**	1		
(1)	Any no-step entrance into the dwelling which (1) is accessible from a substantially level parking or drop-off area (no more than 2%) via an accessible path which has no individual change in elevation or other obstruction of more than 1-1/2 inches in height with the pitch not exceeding 1 in 12 and (2) provides a minimum 32-inch wide clearance into the dwelling.	**3**		☐	
(2)	Minimum 36-inch wide accessible route from the no-step entrance into at least one visiting room in the dwelling and into at least one full or half bathroom which has a minimum 32-inch clear door width and a 30-inch by 48-inch clear area inside the bathroom outside the door swing.	**3**		☐	
(3)	Minimum 36-inch wide accessible route from the no-step entrance into at least one bedroom which has a minimum 32-inch clear door width.	**3**		☐	
(4)	Blocking or equivalent installed in the accessible bathroom walls for future installation of grab bars at water closet and bathing fixture, if applicable.	**1**		☐	
(5)	All interior and exterior door handles are levers rather than knobs.	**1**		☑	
(6)	All sink, lavatory and showering controls that comply with ICC A117.1.	**1**		☐	
(7)	Interior convenience Power receptacles, communication connections (for cable, phone, Ethernet, etc.) and switches are placed between 15" and 48" above the finished floor. Additional switches to control devices and systems (such as alarms, home theaters and other equipment) not required by the local building code may be installed as desired.	**1**		☐	
(8)	All light switches are rocker-type switches or other similar switches that can be operated by pressing them (with assistive devices). Toggle-type switches may not be used.	**1**		☐	
(9)	Any of the following can be controlled with a (wireless) mobile device such as a smartphone, tablet or laptop computer: HVAC, lighting, alarm system or door locks	**1 per system [5 max]**			

613 RESILIENT CONSTRUCTION

613.1	**613.1 Intent.** Design and construction practices developed by a licensed design professional or equivalent are implemented that enhance the resilience and durability of the structure (above building code minimum design loads) so the structure can better withstand forces generated by; flooding, snow, wind or seismic activity (as applicable) and reduce the potential for the loss of life and property.		2	base	seee structural plans
(a)	**Minimum structural requirements (base design).** The building is designed and constructed in compliance with structural requirements in the IBC or IRC as applicable.	**2**			
(b)	**Enhanced resilience – 10% above base design.** Design and construction practices are implemented that enhance the resilience and durability of the structure by designing and building to forces generated by; flooding, snow, wind or seismic (as applicable) that are 10% higher than the base design.	**3**			
(c)	**Enhanced resilience – 20% above base design.**	**5**			
(d)	**Enhanced resilience – 30% above base design.**	**10**			
(e)	**Enhanced resilience – 40% above base design.**	**12**			
(f)	**Enhanced resilience – 50% above base design.**	**15**			

END OF CHAPTER 6

CLICK TO PROCEED TO CHAPTER 7 >>

Current Chapter level: Gold	**Total Points: 67**
Points away from: Bronze: 0, Silver: 0, Gold: 0, Emerald: 3	
Add'l pts earned above: Bronze: 37, Silver: 22, Gold: 7, Emerald: 0	
Total Chapter Points needed for: Bronze: 30, Silver: 45, Gold: 60, Emerald: 70	
Revision Date: 2/28/2024	

NGBS GREEN
Home Innovation Research Labs

Coding

Practice #	Chapter 7: Energy Efficiency	Points Available	Points Claimed	Status	Notes
701 MINIMUM ENERGY EFFICIENCY REQUIREMENTS					
701.1	**701.1 Mandatory requirements.** The building shall comply with Section 702 (Performance Path), Section 703 (Prescriptive Path), or Section 704 (ERI Target Path). Items listed as "mandatory" in Section 701.4 apply to all Paths. Unless otherwise noted, buildings in the Tropical Climate Zone shall comply with Climate Zone 1 requirements.			Select Path: ERI Target	
	Please indicate energy modeler's professional credential and, in the notes field, their name. When selecting "Other," enter professional credentials (e.g., engineer, architect) within the notes field.			Modeler's Credential: HERS Rater	Performance Point
701.1.1	**701.1.1 Minimum Performance Path requirements.** A building complying with § 702 shall include a minimum of two practices from § 705, or a minimum of one practice from § 705 and a minimum of one practice from § 706.				
701.1.2	**701.1.2 Minimum Prescriptive Path requirements.** A building complying with § 703 shall obtain a minimum of 30 points from § 703 and shall include a minimum of two practices from § 705, or a minimum of one practice from § 705 and a minimum of one practice from § 706.				
701.1.3	**701.1.3 ERI Target Path requirements.** A building complying with § 704 shall obtain a minimum of 30 points from § 704 and shall include a minimum of two practices from § 705, or a minimum of one practice from § 705 and a minimum of one practice from § 706.				
701.1.4	**701.1.4 Alternative bronze and silver level compliance**. As an alternative, any building that qualifies as an ENERGY STAR Version 3.0 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev. 03 building or demonstrates compliance with the 2018 IECC or Chapter 11 of the 2018 IRC achieves the bronze level for Chapter 7. As an alternative, any building that qualifies as an ENERGY STAR Version 3.1 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev. 03 (with the baseline at ASHRAE 90.1-2010) building achieves the silver level for Chapter 7. As an alternative in the Tropical Climate Zone, any building that meets all of the requirements in IECC Section R401.2.1 (Tropical Zone) achieves the silver level for Chapter 7. The buildings achieving compliance under Section 701.1.4 are not eligible for achieving a rating level above silver.		0	Alternative: Option:	
701.1.6	**701.1.6 Alternative gold level compliance for tropical zones**. One- or two-family dwelling in the tropical zone at an elevation less than 2,400 feet (731.5 m) above sea level that complies with the following shall achieve the gold level for chapter 7:				
(1)	The residence complies with IECC Tropical Zone than section R401.2.1.	N/A		☐	
(2)	The residence includes a minimum of 2 kW of PV and a minimum of 6 kWh of battery storage.	N/A		☐	
(3)	Any air conditioning has a minimum of 18 SEER.	N/A			
(4)	Solar, wind or other renewable energy source supplies not less than 90 percent of the energy for service water heating.	N/A		☐	
(5)	Glazing in conditioned spaces has a solar heat gain coefficient of less than or equal to 0.25, or has an overhang with a projection factor equal to or greater than 0.30.	N/A			
(6)	The exterior roof/ceiling complies with at least two of the following:				
(a)	Minimum roof reflectance and emittance in IECC Table C402.3	N/A		☐	
(b)	Roof or ceiling has insulation with an R-value of R-15 or greater	N/A		☐	
(c)	Includes a radiant barrier	N/A		☐	
(7)	Walls comply with at least one of the following:				
(a)	Walls have an overhang with a projection factor equal to or greater than 0.30	N/A		☐	
(b)	Walls have insulation with an R-value of R-13 or greater	N/A		☐	
(c)	Walls have a solar reflectance of 0.64	N/A		☐	
(8)	A ceiling fan is provided for bedrooms and the largest space that is not used as a bedroom; alternately a whole house fan is provided.	N/A		☐	
(9)	Wiring sufficient for a Level 2 (208/240V 40-80 amp) electric vehicle charging station is installed on the building site.	N/A		☐	
701.2	**701.2 Emerald level points.** The Performance Path (Section 702) or the ERI Target Path (Section 704) shall be used to achieve the emerald level.				
701.3	**701.3 Adopting Entity review.** A review by the Adopting Entity or designated third party shall be conducted to verify design and compliance with Chapter 7.			☑	Performance Point
	NOTE: List the reviewer in the assigned Notes field.				
701.4	**701.4 Mandatory practices.**				
701.4.1	**701.4.1 HVAC systems.**				
701.4.1.1	**701.4.1.1 HVAC system sizing.** Space heating and cooling system is sized according to heating and cooling loads calculated using ACCA Manual J, or equivalent. Equipment is selected using ACCA Manual S or equivalent.	Mandatory		☑	
701.4.1.2	**701.4.1.2 Radiant and hydronic space heating.** Where installed as a primary heat source in the building, radiant or hydronic space heating system is designed, installed, and documented, using industry-approved guidelines and standards (e.g., ACCA Manual J, AHRI I=B=R, ACCA 5 QI-2010, or an accredited design professional's and manufacturer's recommendations).	Mandatory		No Radiant or Hydronic	
701.4.2	**701.4.2 Duct systems.**				
701.4.2.1	**701.4.2.1 Duct air sealing.** Ducts are air sealed. All duct sealing materials are in conformance with UL 181A or UL 181B specifications and are installed in accordance with manufacturer's instructions.	Mandatory		☑	
701.4.2.2	**701.4.2.2 Ducts and Plenums.** Building framing cavities are not used as ducts or plenums.	Mandatory		☑	
701.4.2.3	**701.4.2.3 Duct system sizing.** Duct system is sized and designed in accordance with ACCA Manual D or equivalent.	Mandatory		☑	

701.4.3		**701.4.3 Insulation and air sealing.**			
701.4.3.1		**701.4.3.1 Building Thermal Envelope Air Sealing.** The building thermal envelope is durably sealed to limit infiltration. The sealing methods between dissimilar materials allow for differential expansion and contraction. The following are caulked, gasketed, weather-stripped or otherwise sealed with an air barrier material, suitable film, or solid material:		701.4.3.3 Exception: ☐	
	(a)	All joints, seams and penetrations.	Mandatory	Met	
	(b)	Site-built windows, doors, and skylights.		N/A	
	(c)	Openings between window and door assemblies and their respective jambs and framing.		Met	
	(d)	Utility penetrations.		Met	
	(e)	Dropped ceilings or chases adjacent to the thermal envelope.		Met	
	(f)	Knee walls.		N/A	
	(g)	Walls, ceilings, and floors separating conditioned spaces from unconditioned.		Met	
	(h)	Behind tubs and showers on exterior walls.		Met	
	(i)	Common walls between dwelling units or sleeping units.		Met	
	(j)	Attic access openings.		N/A	
	(k)	Joints of framing members at rim joists.		Met	
	(l)	Top and bottom plates.		Met	
	(m)	Other sources of infiltration.		Met	
701.4.3.2		**701.4.3.2 Air barrier, air sealing, building envelope testing, and insulation.** Building envelope air barrier, air sealing envelope tightness, and insulation installation is verified to be in accordance with this Section and Section 701.4.3.2.1. Insulation installation other than Grade 1 is not permitted.	Mandatory	ACH50:	
	(1)	**Testing.** Building envelope tightness is tested. Testing is conducted in accordance with ASTM E-779 using a blower door at a test pressure of 1.04 psf (50 Pa). Testing is conducted after rough-in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances. Testing is conducted under the following conditions:		6.00 ELR:	
	(a)	Exterior windows and doors, fireplace and stove doors are closed, but not sealed;			
	(b)	Dampers are closed, but not sealed, including exhaust, intake, makeup air, backdraft and flue dampers;			
	(c)	Interior doors are open;			
	(d)	Exterior openings for continuous ventilation systems and heat recovery ventilators are closed and sealed;			
	(e)	Heating and cooling systems are turned off;			
	(f)	HVAC duct terminations are not sealed; and			
	(g)	Supply and return registers are not sealed.			
		Multifamily Building Note: Testing by dwelling units, sleeping units, groups of dwelling units, groups of sleeping units, or the building as a whole is acceptable.			
	(2)	**Visual inspection.** The air barrier and insulation items listed in Table 701.4.3.2(2) are field verified by visual inspection. See Table 701.4.3.2(2)		☑	
701.4.3.2.1		**701.4.3.2.1 Grade I insulation installations.** Field-installed insulation products to ceilings, walls, floors, band joists, rim joists, conditioned attics, basements, and crawlspaces, except as specifically noted, are verified as Grade I by a third-party are in accordance with the following:	Mandatory	☑	
	(1)	Inspection is conducted before insulation is covered.			Grade 1 Insulation is mandatory for the NGBS
	(2)	Air-permeable insulation is enclosed on all six sides and is in substantial contact with the sheathing material on one or more sides (interior or exterior) of the cavity. Air permeable insulation in ceilings is not required to be enclosed when the insulation is installed in substantial contact with the surfaces it is intended to insulate.			
	(3)	Cavity insulation uniformly fills each cavity side-to-side and top-to-bottom, without substantial gaps or voids around obstructions (such as blocking or bridging).			
	(4)	Cavity insulation compression or incomplete fill amounts to 2 percent or less, presuming the compressed or incomplete areas are a minimum of 70 percent of the intended fill thickness; occasional small gaps are acceptable.			
	(5)	Exterior rigid insulation has substantial contact with the structural framing members or sheathing materials and is tightly fitted at joints.			
	(6)	Cavity insulation is split, installed, and/or fitted tightly around wiring and other services.			
	(7)	Exterior sheathing is not visible from the interior through gaps in the cavity insulation.			
	(8)	Faced batt insulation is permitted to have side-stapled tabs, provided the tabs are stapled neatly with no buckling, and provided the batt is compressed only at the edges of each cavity, to the depth of the tab itself.			
	(9)	Where properly installed, ICFs, SIPs, and other wall systems that provide integral insulation are deemed in compliance with this section.			
701.4.3.3		**701.4.3.3 Multifamily air leakage alternative.** Multifamily buildings four or more stories in height and in compliance with IECC section C402.5 (Air leakage-thermal envelope) are deemed to comply with Sections 701.4.3.1 and 701.4.3.2.		See 701.4.3.1	
701.4.3.4		**701.4.3.4 Fenestration air leakage.** Windows, skylights and sliding glass doors have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m2), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m2), when tested in accordance with NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled. For site-built fenestration, a test report by an accredited, independent laboratory verifying compliance with the applicable infiltration rate shall be submitted to demonstrate compliance with this practice. This practice does not apply to field-fabricated fenestration products. **Exception:** For Tropical Zones Only, Jalousie windows are permitted to be used as a conditioned space boundary and shall have an air infiltration rate of not more than 1.3 cfm per square foot.	Mandatory	☑	
701.4.3.5		**701.4.3.5 Lighting in building thermal envelope.** Luminaires installed in the building thermal envelope which penetrate the air barrier are sealed to limit air leakage between conditioned and unconditioned spaces. All luminaires installed in the building thermal envelope which penetrate the air barrier are IC-rated and labeled as meeting ASTM E283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity. All luminaires installed in the building thermal envelope which penetrate the air barrier are sealed with a gasket or caulk between the housing and the interior of the wall or ceiling covering.	Mandatory	N/A	
701.4.4		**701.4.4 High-efficacy lighting.** Lighting efficacy in dwelling units or sleeping units is in accordance with one of the following:	Mandatory		
	(1)	A minimum of 75 percent of the total hard-wired lighting fixtures or the bulbs in those fixtures qualify as high efficacy or equivalent		☑	
	(2)	Lighting power density, measured in watts/square foot, is 1.1 or less.		☐	
701.4.5		**701.4.5 Boiler piping.** Boiler piping in unconditioned space supplying and returning heated water or steam is insulated.	N/A	☐	

702 PERFORMANCE PATH

702.1	**702.1 Point allocation.** Points from Section 702 (Performance Path) shall not be combined with points from Section 703 (Prescriptive Path) or Section 704 (ERI Target Path).				
702.2	**702.2 Energy performance levels.**				
702.2.1	**702.2.1 ICC IECC analysis.** Energy efficiency features are implemented to achieve energy cost or source energy performance that meets the ICC IECC. A documented analysis using software in accordance with ICC IECC, Section R405, or ICC IECC Section C407.2 through C407.5, applied as defined in the ICC IECC, is required.	N/A		☐	
702.2.2	**702.2.2 Energy performance analysis.** Energy savings levels above the ICC IECC are determined through an analysis that includes improvements in building envelope, air infiltration, heating system efficiencies, cooling system efficiencies, duct sealing, water heating system efficiencies, lighting, appliances, and on-site renewable energy. Points are assigned using the following formula: **Points = 30 + (percent above NGBS Reference Home) * 2** Multifamily Building Note: Modeling is completed building-wide using one of the following methods: whole building energy modeling, a unit-by-unit approach, or a building average of a unit-by-unit approach.	**Points per formula**	0	Percent above NGBS Reference Home:	
702.2.3	**702.2.3 Tropical standard reference design.** For the Tropical Climate Zone, the standard reference design shall use the specifications in IECC Section R401.2.1 (Tropical Zone).				

703 PRESCRIPTIVE PATH

703.1	**703.1 Mandatory practices.**	**30**	**0**		
703.1.1	**703.1.1 Building thermal envelope compliance.** The building thermal envelope is in compliance with Section 703.1.1.1 or 703.1.1.2. Exception: Section 703.1.1 is not required for Tropical Climate Zone.	N/A		☐	
703.1.1.1	**703.1.1.1 Maximum UA and SHGC.** For IECC residential buildings, the total building UA is less than or equal to the total maximum UA as computed by ICC IECC Section R402.1.5. The SHGC requirements for fenestration in Table R402.1.2 are also met. For IECC commercial buildings, the total UA is less than or equal to the sum of the UA for ICC IECC Tables C402.1.4 and C402.4, including the U-factor times the area and C-factor or F-factor times the perimeter. The SHGC requirements for fenestration in Table C402.4 are also met. The total UA proposed and baseline calculations are documented. REScheck or COMcheck is deemed to provide UA calculation documentation.				
703.1.1.2	**703.1.1.2 Prescriptive R-values and fenestration requirements**. The building thermal envelope is in accordance with the insulation and fenestration requirements of ICC IECC Table R402.1.2 or Tables C402.1.3. The fenestration U-factors and SHGC's are in accordance with Table 703.2.5.1 or ICC IECC Table C402.4.				
703.1.2	**703.1.2 Building envelope leakage.** The building thermal envelope is in accordance with ICC IECC R402.4.1.2 or C402.5 as applicable. Exception: Section 703.1.2 is not required for Tropical Climate Zone	N/A		☐	
703.1.3	**703.1.3 Duct Testing.** The duct system is in accordance with ICC IECC R403.3.2 through R403.3.5 as applicable.	N/A		Rough-In Test: Postconstruction Test:	
703.2	**703.2 Building envelope**				
703.2.1	**703.2.1 UA improvement.** The total building thermal envelope UA is less than or equal to the baseline total UA resulting from the U-factors provided in Table 703.2.1(a) or ICC IECC Tables C402.1.4 and C402.4, as applicable. Where insulation is used to achieve the UA improvement, the insulation installation is in accordance with Grade 1 meeting Section 701.4.3.2.1 as verified by a third-party. Total UA is documented using a RESCheck, COMCheck, or equivalent report to verify the baseline and the UA improvement. See Table 703.2.1(a)	Per Table 703.2.1(b)	0	☐ UA Improvement:	
703.2.2	**703.2.2 Mass walls.** More than 75 percent of the above-grade exterior opaque wall area of the building is mass walls.	Per Table 703.2.2	0	Mass thickness:	
703.2.3	**703.2.3** A radiant barrier with an emittance of 0.05 or less is used in the attic. The product is tested in accordance with ASTM C1371 and installed in accordance with the manufacturer's instructions.	**1**	0	☐	
703.2.4	**703.2.4 Building envelope leakage**. The maximum building envelope leakage rate is in accordance with Table 703.2.4a or Table 703.2.4b and whole building ventilation is provided in accordance with Section 902.2.1.	Per Table 703.2.4a or 703.2.4b	0	Air leakage from 701.4.3.2 or 705.6.2.1: 6.00	
703.2.5	**703.2.5 Fenestration**				
703.2.5.1	**703.2.5.1** NFRC-certified (or equivalent) U-factor and SHGC of windows, exterior doors, skylights, and tubular daylighting devices (TDDs) on an area-weighted average basis do not exceed the values in Table 703.2.5.1. Area weighted averages are calculated separately for the categories of 1) windows and exterior doors and 2) skylights and tubular daylighting devices (TDDs). Decorative fenestration elements with a combined total maximum area of 15 square feet (1.39 m2) or 10 percent of the total glazing area, whichever is less, are not required to comply with this practice. See Table 703.2.5.1	N/A			
703.2.5.1.1	**703.2.5.1.1 Dynamic glazing.** Dynamic glazing is permitted to satisfy the SHGC requirements of Table 703.2.5.1 provided the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4 and the dynamic glazing is automatically controlled to modulate the amount of solar gain into the space in multiple steps. Fenestration with dynamic glazing is considered separately from other fenestration and area-weighted averaging with fenestration that does not use dynamic glazing is not permitted. Dynamic glazing is not required to be automatically controlled or comply with minimum SHGC ratio when both the lower and higher labeled SHGC already comply with the requirements of Table 703.2.5.1.				
703.2.5.2	**703.2.5.2** The NFRC-certified (or equivalent) U-factor and SHGC of windows, exterior doors, skylights, and tubular daylighting devices (TDDs) are in accordance with Table 703.2.5.2(a), (b), or (c). Decorative fenestration elements with a combined total maximum area of 15 square feet (1.39 m^2) or 10 percent of the total glazing area, whichever is less, are not required to comply with this practice.	Per Table 703.2.5.2(a) or 703.2.5.2(b) or 703.2.5.2(c)	0		
	(a) Table 703.2.5.2(a)	**3**			
	(b) Table 703.2.5.2(b)	**4**			
	(c) Table 703.2.5.2(c)	**6**			
703.2.5.2.1	**703.2.5.2.1 Dynamic glazing.** Dynamic glazing is permitted to satisfy the SHGC requirements of Tables 703.2.5.2(a), 703.2.5.2(b), and 703.2.5.2(c) provided the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4, and the dynamic glazing is automatically controlled to modulate the amount of solar gain into the space in multiple steps. Fenestration with dynamic glazing is considered separately from other fenestration, and area-weighted averaging with fenestration that does not use dynamic glazing is not permitted. Dynamic glazing is not required to be automatically controlled or comply with minimum SHGC ratio when both the lower and higher labeled SHGC already comply with the requirements of Tables 703.2.5.2(a), 703.2.5.2(b), and 703.2.5.2(c).				

703.3		**HVAC equipment efficiency**				
703.3.0		**703.3.0 Multiple heating and cooling systems.** For multiple heating or cooling systems in one home, practices 703.3.1 through 703.3.6 apply to the system that supplies 80% or more of the total installed heating or cooling capacity. Where multiple systems each serve less than 80% of the total installed heating or cooling capacity, points under Sections 703.3.1 through 703.3.6 are awarded either for the system eligible for the fewest points or the weighted average of the systems. The weighted average shall be calculated in accordance with the following equation and be based upon the efficiency and capacity of the equipment as selected in accordance with ACCA Manual S with it loads calculated in accordance with ACCA Manual J. Weighted Average = $[(E_{unit\,1}*C_{unit\,1})+(E_{unit\,2}*C_{unit\,2})+\ldots+(E_{unit\,n}*C_{unit\,n})] / (C_{unit\,1}+C_{unit\,2}+\ldots+C_{unit\,n})$ where: E = Rated AHRI efficiency for unit C = Rated heating or cooling capacity for unit *n* = Unit count			multiple heating sys.? multiple cooling sys.?	
703.3.1		**703.3.1** Combination space heating and water heating system (combo system) is installed using either a coil from the water heater connected to an air handler to provide heat for the building, dwelling unit or sleeping unit, or a space heating boiler using an indirect-fired water heater. Devices have a minimum combined annual efficiency of 0.80 and a minimum water heating recovery efficiency of 0.87.	**4**	0	☐	
703.3.2		**703.3.2** Furnace and/or boiler efficiency is in accordance with one of the following:				
	(1)	Gas and propane heaters:		0	Min. or Average AFUE:	
		≥90% AFUE	**6**			
		≥92% AFUE	**7**			
		≥94% AFUE	**9**			
		≥96% AFUE	**10**			
		≥98% AFUE	**11**			
	(2)	Oil furnace:		0	Min. or Average AFUE:	
		≥85% AFUE	**3**			
		≥90% AFUE	**6**			
	(3)	Gas boiler:		0	Min. or Average AFUE:	
		≥85% AFUE	**2**			
		≥90% AFUE	**4**			
		≥94% AFUE	**5**			
		≥96% AFUE	**6**			
	(4)	Oil boiler:		0	Min. or Average AFUE:	
		≥85% AFUE	**3**			
		≥90% AFUE	**5**			
703.3.3		**703.3.3** Heat pump heating efficiency is in accordance with Table 703.3.3(1) or Table 703.3.3(2) or Table 703.3.3(3). Refrigerant charge is verified for compliance with manufacturer's instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010.				
	(1)	Electric Heat Pump Heating		0	Min. or Average HSPF:	
		≥8.5 HSPF	**2**			
		≥9.0 HSPF	**5**			
		≥9.5 HSPF	**7**			
		≥10.0 HSPF	**10**			
		≥12.0 HSPF	**11**		Min. or Average HSPF:	
	(2)	Electric Heat Pump Heating for Multifamily Buildings Four or More Stories in Height	**8**	0		
					Min. or Average COP:	
	(3)	Gas Engine-Driven Heat Pump Heating (≥1.3 COP at 47°F)	**14**	0		
703.3.4		**703.3.4** Cooling efficiency is in accordance with Table 703.3.4(1) or Table 703.3.4(2). Refrigerant charge is verified for compliance with manufacturer's instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010.				
	(1)	Electric Air Conditioner and Heat Pump Cooling		0	Min. or Average SEER:	
		≥15 SEER	**1**			
		≥17 SEER	**3**			
		≥19 SEER	**6**			
		≥21 SEER	**8**			
		≥25 SEER	**10**			
	(*)	Tropical Climate Zone: None of the occupied space is air conditioned and ceiling fans are provided for bedrooms and the largest space which is not used as a bedroom.	**20**	0	☐	
					Min. or Average COP:	
	(2)	Gas Engine-Driven Heat Pump Cooling (≥1.2 COP at 95°F)	**1**	0		
703.3.5		**703.3.5** Water source cooling and heating efficiency is in accordance with Table 703.3.5. Refrigerant charge is verified for compliance with manufacturer's instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010. ≥15 SEER, ≥4.0 COP	**30**	0	☐	
703.3.6		**703.3.6** Ground source heat pump is installed by a Certified Geothermal Service Contractor in accordance with Table 703.3.6. Refrigerant charge is verified for compliance with manufacturer's instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010.		0	Min. or Average EER:	
		≥16 EER, ≥3.6 COP	**16**			
		≥24 EER, ≥4.3 COP	**31**			
		≥28 EER, ≥4.8 COP	**42**			
703.3.7		**703.3.7** ENERGY STAR, or equivalent, ceiling fans are installed. **(Points awarded per building.)** **Note for Tropical Climate Zone and Climate Zones 2B, 3B, and 4B: points awarded per fan where AC is not installed in the dwelling unit or sleeping unit (Max 8 points), and where points awarded in Section 703.3.8 for these specific climate zones, points shall not be awarded in Section 703.3.7** NOTE: For multi-unit buildings, each dwelling unit must comply to claim this point.	**1**	0	☐ # of fans:	
703.3.8		**703.3.8** Whole-building or whole-dwelling unit or whole-sleeping unit fan(s) with insulated louvers and a sealed enclosure is installed. **(Points awarded per building.)** NOTE: For multi-unit buildings, each dwelling unit must have compliant whole-dwelling unit fans installed to claim these points.	**3**	0	☐	
703.4		**703.4 Duct Systems**				
703.4.1		**703.4.1** All space heating is provided by a system(s) that does not include air ducts. (No points awarded for multifamily buildings four or more stories in height.)	**6**	0	☐	
703.4.2		**703.4.2** All space cooling is provided by a system(s) that does not include air ducts. (No points awarded for multifamily buildings four or more stories in height.)	**2**	0	☐	
703.4.3		**703.4.3** Ductwork is in accordance with all of the following:	**8**	0		
	(1)	Building cavities are not used as return ductwork.			☐	
	(2)	Heating and cooling ducts and mechanical equipment are installed within the conditioned building space.			☐	
	(3)	Ductwork is not installed in exterior walls. (No points awarded for multifamily buildings four or more stories in height.)			☐	
703.4.4		**703.4.4 Duct Leakage.** The entire central HVAC duct system, including air handlers and register boots, is tested by a third party for total leakage at a pressure differential of 0.1 inches w.g. (25 Pa) and maximum air leakage is equal to or less than 6 percent of the system design flow rate or 4 cubic feet per minute per 100 square feet of conditioned floor area. **(Points not awarded if points are taken under Section 705.6.2.3)**		0		
	(1)	ductwork entirely outside the building's thermal envelope	**3**			
	(2)	ductwork entirely inside the building's thermal envelope	**1**			
	(3)	ductwork inside and outside the building's thermal envelope	**2**			

703.5		**703.5 Water heating system**				
703.5.1		**703.5.1** Water heater Uniform Energy Factor (UEF) is in accordance with the following:			type:	
		Where multiple systems are used, points awarded based on the system with the lowest efficiency.				
		Water heater design is based on only 1 (one) water heater per dwelling unit, based on approved methods from IPC or ASPE or manufacturer specifications.				
		All table values are based on water heaters with medium water draws as defined by the US DOE text procedures (55 gallons per day).			type:	
	(1)	Gas water heating				
	(a)	Storage Water Heater, Rated Storage Volume > 20 Gallons and ≤ 55 Gallons, Medium Water Draw		0	efficiency:	
		UEF: 0.65 to <0.78	**2**			
		UEF: ≥0.78	**3**			
	(b)	Storage Water Heater, Rated Storage Volume > 55 Gallons and ≤ 100 Gallons, Medium Water Draw	**1**	0		
	(c)	Storage Water Heater with Input Rate Greater than 75,000 Btu/h (Commercial)		0		
		Thermal Efficiency: 0.90 to < 0.95	**3**			
		Thermal Efficiency: ≥0.95	**4**			
	(d)	Storage Water Heater with Input Rate Greater than 75,000 Btu/H (Commercial), In Buildings with High-Capacity Service Water-Heating Systems (1,000,000 Btu/h or Greater)		0		
		Thermal Efficiency: 0.92 to < 0.95	**1**			
		Thermal Efficiency: ≥0.95	**2**			
	(e)	Instantaneous Water Heater, Rated Storage Volume < 2 Gallons and Input Rate of > 50,000 Btu/h, Medium Water Draw		0		
		UEF: 0.89 to < 0.94	**1**			
		UEF: ≥0.94	**2**		type:	
	(2)	Electric water heating				
	(a)	Storage Water Heater, Rated Storage Volume ≥ 20 Gallons and ≤ 55 Gallons, Medium Water Draw		0	efficiency:	
		UEF: 0.94 to <1.0	**1**			
		UEF: 1.0 to <1.5	**2**			
		UEF: 1.5 to <2.0	**2**			
		UEF: 2.0 to <2.2	**5**			
		UEF: 2.2 to <2.5	**6**			
		UEF: 2.5 to <3.0	**8**			
		UEF: ≥3.0	**11**			
	(b)	Storage Water Heater, Rated Storage Volume ≥ 55 Gallons and ≤ 120 Gallons, Medium Water Draw		0		
		UEF: 2.2 to <2.5	**3**			
		UEF: 2.5 to <3.0	**3**			
		UEF: 3.0 to <3.5	**4**			
		UEF: ≥3.5	**5**			
	(c)	Electric Tabletop Water Heating (Tabletop Water Heater, Rated Storage Volume ≥ 20 Gallons and ≤ 120 Gallons, Medium Water Draw)	**1**	0		
	(d)	Electric Instantaneous Water Heating (Instantaneous Electric Water Heater, Rated Storage Volume < 2 Gallons, Medium Water Draw)	**1**	0		
	(e)	Electric Grid Enabled Water Heating (Grid Enabled Storage Water Heater, Rated Storage Volume ≥ 75 Gallons, Medium Water Draw)	**2**	0		
	(3)	Oil water heating (Oil water heating, < 50 gallons, Medium water draw)	**1**	0	efficiency:	
703.5.2		**703.5.2** Desuperheater is installed by a qualified installer or is pre-installed in the factory.	**7**	0	☐	
703.5.3		**703.5.3** Drain-water heat recovery system is installed. **(Points awarded per building.)**	**2**	0	☐	
703.5.4		**703.5.4** Indirect-fired water heater storage tanks heated from boiler systems are installed.	**1**	0	☐	
703.5.5		**703.5.5 Solar water heater.** SRCC (Solar Rating & Certification Corporation) OG 300 rated, or equivalent, solar domestic water heating system is installed. Solar Energy Factor (SEF) as defined by SRCC is in accordance with Table 703.5.5(a) and Table 703.5.5(b).			type:	
	(a)	Storage Water Heater, Rated Storage Volume of Backup Water Heater is ≥ 0.1 Gallon and ≤ 55 Gallons, Medium Water Draw		0	SEF:	
		SEF ≥ 1.3	**5**			
		SEF ≥ 1.51	**6**			
		SEF ≥ 1.81	**9**			
		SEF ≥ 2.31	**14**			
		SEF ≥ 3.01	**23**			
	(b)	Storage Water Heater, Rated Storage Volume of Backup Water Heater is >55 Gallons, Medium Water Draw		0		
		SEF ≥ 1.3	**5**			
		SEF ≥ 1.51	**7**			
		SEF ≥ 1.81	**10**			
		SEF ≥ 2.31	**16**			
		SEF ≥ 3.01	**23**			
703.6		**703.6 Lighting and appliances**				
703.6.1		**703.6.1 Hard-wired lighting.** Hard-wired lighting is in accordance with one of the following:				
	(1)	A minimum percent (*95%*) of the total hard-wired interior luminaires or lamps qualify as ENERGY STAR, DesignLights Consortium (DLC), or applicable equivalent.	**2**	0	☐	
	(2)	A minimum of 80 percent of the exterior lighting wattage has a minimum efficacy of 61 lumens per watt or is solar-powered.	**1**	0	☐	
	(3)	In multifamily buildings, common area lighting power density (LPD) is less than 0.51 Watts per square foot.	**7**	0	☐	
703.6.2		**703.6.2 Appliances.** ENERGY STAR or equivalent appliance(s) are installed:				
	(1)	Refrigerator	**1**	0	☐	
	(2)	Dishwasher	**1**	0	☐	
	(3)	Washing machine	**4**	0	☐	
		Multifamily Building Note: Washing machines in ALL units must comply.				

703.7		**703.7 Passive solar design**				
703.7.1		**703.7.1 Sun-tempered design.** Building orientation, sizing of glazing, and design of overhangs are in accordance with all of the following:	**4**	0	☐	
	(1)	The long side (or one side if of equal length) of the building faces within 20 degrees of true south.				
	(2)	Vertical glazing area is between 5 and 7 percent of the gross conditioned floor area on the south face [also see Section 703.7.1(8)] and glazing U-factors meet Table 703.2.5.2(a).				
	(3)	Vertical glazing area is less than 2 percent of the gross conditioned floor area on the west face, and glazing meets Table 703.2.5.2(a).				
	(4)	Vertical glazing area is less than 4 percent of the gross conditioned floor area on the east face, and glazing meets Table 703.2.5.2(a).				
	(5)	Vertical glazing area is less than 8 percent of the gross conditioned floor area on the north face, and glazing meets Table 703.2.5.2(a).				
	(6)	Skylights, where installed, are in accordance with the following:				
	(a)	shades and insulated wells are used, and all glazing meets Table 703.2.5.2(a)				
	(b)	horizontal skylights are less than 0.5 percent of finished ceiling area				
	(c)	sloped skylights on slopes facing within 45 degrees of true south, east, or west are less than 1.5 percent of the finished ceiling area				
	(7)	Overhangs or adjustable canopies or awnings or trellises provide shading on south-facing glass for the appropriate climate zone in accordance with Table 703.7.1(7): See Table 703.7.1(7)				
	(8)	The south face windows have a SHGC of 0.40 or higher.				
	(9)	Return air or transfer grilles/ducts are in accordance with Section 705.4.				
		Multifamily Building Note: The site is designed such that at least 40 percent of the multifamily dwelling or sleeping units have one south facing wall (within 15 degrees) containing at least 50 percent of glazing for entire unit, Effective shading is required for passive solar control on all south facing glazing. The floor area of at least 15 feet from the south facing perimeter glazing is massive and exposed to capture solar heat during the day and reradiate at night.				
703.7.2		**703.7.2 Window shading.** Automated solar protection or dynamic glazing is installed to provide shading for windows.	**1**	0	☐	
703.7.3		**703.7.3 Passive cooling design.** Passive cooling design features are in accordance with three or more of the following:		0		
		Points for three items:	**3**			
		Points for one additional item:	**1**			
	(1)	Exterior shading is provided on east and west windows using one or a combination of the following:				
	(a)	vine-covered trellises with the vegetation separated a minimum of 1 foot (305 mm) from face of building			☐	
	(b)	moveable awnings or louvers			☐	
	(c)	covered porches			☐	
	(d)	attached or detached conditioned/unconditioned enclosed space that provides full shade of east and west windows (e.g., detached garage, shed, or building)			☐	
	(2)	Overhangs are installed to provide shading on south-facing glazing in accordance with Section 703.7.1(7). **(Points not awarded if points are taken under Section 703.7.1.)**			☐	
	(3)	Windows and/or venting skylights are located to facilitate cross and stack effect ventilation.			☐	
	(4)	Solar reflective roof or radiant barrier is installed in climate zones 1, 2, or 3 and roof material achieves a 3-year aged criteria of 0.50.			☐	
	(5)	Internal exposed thermal mass is a minimum of three inches (76 mm) in thickness. Thermal mass consists of concrete, brick, and/or tile fully adhered to a masonry base or other masonry material in accordance with one or a combination of the following:				
	(a)	A minimum of 1 square foot (0.09 m^2) of exposed thermal mass of floor per 3 square feet (2.8 m^2) of gross finished floor area.			☐	
	(b)	A minimum of 3 square feet (2.8 m^2) of exposed thermal mass in interior walls or elements per square foot (0.09 m^2) of gross finished floor area.			☐	
	(6)	Roofing material is installed with a minimum 0.75 inch (19 mm) continuous air space offset from the roof deck from eave to ridge.			☐	
703.7.4		**703.7.4 Passive solar heating design**. In addition to the sun-tempered design features in Section 703.7.1, all of the following are implemented: Note: Points shall not be awarded in the Tropical Climate Zone.	**4**	0	☐	
	(1)	Additional glazing, no greater than 12 percent, is permitted on the south wall. This additional glazing is in accordance with the requirements of Section 703.7.1.				
	(2)	Additional thermal mass for any room with south-facing glazing of more than 7 percent of the finished floor area is provided in accordance with the following:				
	(a)	Thermal mass is solid and a minimum of 3 inches (76 mm) in thickness. Where two thermal mass materials are layered together (e.g., ceramic tile on concrete base) to achieve the appropriate thickness, they are fully adhered to (touching) each other.				
	(b)	Thermal mass directly exposed to sunlight is provided in accordance with the following minimum ratios:				
	(i)	Above latitude 35 degrees: 5 square feet (0.465 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.				
	(ii)	Latitude 30 degrees to 35 degrees: 5.5 square feet (0.51 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.				
	(iii)	Latitude 25 degrees to 30 degrees: 6 square feet (0.557 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.				
	(c)	Thermal mass not directly exposed to sunlight is permitted to be used to achieve thermal mass requirements of Section 703.7.4 (2) based on a ratio of 40 square feet (3.72 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.				
	(3)	In addition to return air or transfer grilles/ducts required by Section 703.7.1(9), provisions for forced airflow to adjoining areas are implemented as needed.				

704 ERI TARGET PATH

704.1	**704.1 ERI target compliance.** Compliance with the energy chapter shall be permitted to be based on the EPA National ERI Target Procedure for Energy Star Certified Homes. Points from Section 704 (ERI Target) shall not be combined with points from Section 702 (Performance Path) or Section 703 (Prescriptive Path). Dwelling ratings shall be submitted to a Rating Certification Body approved by the Adopting Entity for calculating points under this section.		56	EPA National ERI Target:	Preliminary Target & Design numbers, results from Energy Model
704.2	**704.2 Point calculation.** Points for Section 704 shall be computed based on Step "1" of the EPA National ERI Target Procedure. Points shall be computed individually for each building as follows: **30 + (Number of National ERI Points less than EnergyStar National ERI Target for that building) * 2.**			76 ERI As Designed: 63	

705 ADDITIONAL PRACTICES

705.2		**705.2 Lighting**				
705.2.1		**705.2.1 Lighting controls** **(Percentages for point thresholds are based on lighting not required for means of egress or security lighting as defined by local building codes.)**				
705.2.1.1		**705.2.1.1 Interior lighting.** In dwelling units or sleeping units, permanently installed interior lighting fixtures are controlled with an occupancy sensor, or dimmer:		0		
	(1)	50 percent to less than 75 percent of lighting fixtures.	**1**			
	(2)	A minimum of 75 percent of lighting fixtures.	**2**			
705.2.1.2		**705.2.1.2 Exterior lighting.** Photo or motion sensors are installed on 75 percent of outdoor lighting fixtures to control lighting.	**1**	1	☑	Photo
705.2.1.3		**705.2.1.3 Multifamily common areas.**				
	(1)	In a multifamily building, occupancy sensors, or dimmers are installed in common areas (except corridors and stairwells).		0		
	(a)	50 percent to less than 75 percent of lighting fixtures.	**1**			
	(b)	A minimum of 75 percent of lighting fixtures.	**2**			
	(2)	In a multifamily building, occupancy controls are installed to automatically reduce light levels in interior corridors and exit stairwells when the space is unoccupied. Light levels are reduced by:		0		
	(a)	50 percent to less than 75 percent or to local minimum requirements	**2**			
	(b)	A minimum of 75 percent	**3**			
705.2.1.4		**705.2.1.4** In a multifamily building, occupancy controls are installed to automatically reduce light levels in garages and parking structures when the space is unoccupied. Light levels are reduced by:		0		
	(1)	50 percent to less than 75 percent or to local minimum requirements	**2**			
	(2)	A minimum of 75 percent	**3**			
705.2.2		**705.2.2 TDDs and skylights.** A tubular daylighting device (TDD) or a skylight that meets the requirements of Table 703.2.5.2(a) is installed in rooms without windows. **(Points awarded per building.)**	**2**	0	☐	
705.2.3		**705.2.3 Lighting outlets.** Occupancy sensors are installed for a minimum of 80 percent of hard-wired lighting outlets in the interior living space.	**1**	0	☐	
705.2.4		**705.2.4 Recessed luminaires.** The number of recessed luminaires that penetrates the thermal envelope is less than 1 per 400 square feet (37.16 m^2) of total conditioned floor area and they are in accordance with Section **701.4.3.5**.	**1**	1	# of luminaires: 0 luminaires per 130776 square feet	
705.3		**705.3 Induction cooktop.** Induction cooktop is installed.	**1**	0	☐	
705.4		**705.4 Return ducts and transfer grilles.** Return ducts or transfer grilles are installed in every room with a door. Return ducts or transfer grilles are not required for bathrooms, kitchens, closets, pantries, and laundry rooms.	**2**	2	☑	
705.5		**705.5 HVAC design and installation**				
705.5.1		**705.5.1** Meet one or both of the following:				
	(1)	HVAC contractor is certified by the Air Conditioning Contractors of Americas Quality Assured Program (ACCA/QA) or by an EPA-recognized HVAC Quality Installation Training Oversight Organization (H-QUITO) or equivalent.	**1**	0	☐	need to check on this
	(2)	HVAC installation technician(s) is certified by North American Technician Excellence, Inc. (NATE) or equivalent.	**1**	0	☐	
705.5.2		**705.5.2** Performance of the heating and/or cooling system is verified by the HVAC contractor in accordance with all of the following:	**3**	0	☐	
	(1)	Start-up procedure is performed in accordance with the manufacturer's instructions.				
	(2)	Refrigerant charge is verified by super-heat and/or sub-cooling method.				
	(3)	Burner is set to fire at input level listed on nameplate.				
	(4)	Air handler setting/fan speed is set in accordance with manufacturer's instructions.				
	(5)	Total airflow is within 10 percent of design flow.				
	(6)	Total external system static does not exceed equipment capability at rated airflow.				
705.5.3		**705.5.3** HVAC Design is verified by 3rd party as follows:				
	(1)	The ENERGY STAR HVAC Design and Rater Design Review Checklists are completed and correct.	**3**	0	☐	
	(2)	HVAC Installation is inspected and conforms to HVAC design documents and plans.	**3**	3	☑	
705.6		**705.6 Installation and performance verification.**				
705.6.1		**705.6.1** Third-party on-site inspection is conducted to verify compliance with all of the following, as applicable. Minimum of two inspections are performed: one inspection after insulation is installed and prior to covering, and another inspection upon completion of the building. Where multiple buildings or dwelling units of the same model or sleeping units of the same model are built by the same builder, a representative sample inspection of a minimum of 15 percent of the buildings or dwelling units or sleeping units is permitted.	**3**	3	By using this tool, this project automatically qualifies for this practice.	

705.6.2		**705.6.2 Testing.** Testing is conducted to verify performance:				
705.6.2.1		**705.6.2.1 Air leakage validation of building or dwelling units or sleeping units.** A visual inspection is performed as described in 701.4.3.2(2) and air leakage testing is performed in accordance with ASTM E779 or ASTM E1827. **(Points awarded only for buildings where building envelope leakage testing is not required by ICC IECC.)** **(Points not awarded if points are taken under Section 703.2.4)**			ACH50:	
	(1)	A blower door test.	**3**	0	ELR:	
	(2)	Third-party verification is completed. NOTE: Specify name of person or company conducting blower door test in the assigned Notes area.	**5**	0	☐	
705.6.2.2		**705.6.2.2 HVAC airflow testing.** Balanced HVAC airflows are demonstrated by flow hood or other acceptable flow measurement tool by a third party. Test results are in accordance with the following:				
	(1)	Measured flow at each supply and return register meets or exceeds the requirements in ACCA 5 QI-2010, Section 5.2.	**5**	0	☐	
	(2)	Total airflow meets or exceeds the requirements in ACCA 5 QI-2010, Section 5.2. NOTE: Specify name of person or company conducting HVAC airflow test in the assigned Notes area.	**3**	0	☐	
705.6.2.3		**705.6.2.3 HVAC duct leakage testing.** One of the following is achieved: **(Points awarded only where these practices are not required by IECC.)** **(Points not awarded if points are taken under Section 703.4.4)**		0		
	(1)	Duct leakage is in accordance with IECC R403.3.3 and R403.3.4.	**3**			
	(2)	Duct leakage is in accordance with IECC R403.3.3 and R403.3.4, and testing is conducted by an independent third party.	**5**			
705.6.3		**705.6.3 Insulating hot water pipes.** Insulation with a minimum thermal resistance (R-value) of at least R-3 is applied to the following, as applicable: **(Points awarded only where these practices are not required by IECC.)**	**1**	0	☐ ☐	required by IECC:
	(a)	piping 3/4-inch and larger in outside diameter				
	(b)	piping serving more than one dwelling unit or sleeping unit				
	(c)	piping located outside the conditioned space				
	(d)	piping from the water heater to a distribution manifold				
	(e)	piping located under a floor slab				
	(f)	buried piping				
	(g)	supply and return piping in recirculation systems other than demand recirculation systems				
705.6.4		**705.6.4 Potable hot water demand re-circulation system.**				
705.6.4.1		**705.6.4.1** Potable hot water demand re-circulation system is installed in a single-family unit.	**1**	0	☐	
705.6.4.2		**705.6.4.2** Potable hot water demand re-circulation system(s) that serves every unit in a multifamily building is installed in place of a standard circulation pump and control.	**2**	0	☐	
705.7		**705.7** In multi-unit buildings, an advanced electric and fossil fuel submetering system is installed to monitor electricity and fossil fuel consumption for each unit. The device provides consumption information on a monthly or near real-time basis. The information is available to the occupants at a minimum on a monthly basis.	**1**	1	☑	

706 INNOVATIVE PRACTICES

706.1		**706.1 Energy consumption control.** A whole-building or whole-dwelling unit or whole-sleeping unit device or system is installed that controls or monitors energy consumption.	**3 Max**	0		
	(1)	programmable communicating thermostat with the capability to be controlled remotely	**1**		☐	
	(2)	energy-monitoring device or system	**1**		☐	
	(3)	energy management control system	**3**		☐	
	(4)	programmable thermostat with control capability based on occupant presence or usage pattern	**1**		☐	
	(5)	lighting control system	**1**		☐	
706.2		**706.2 Renewable energy service plan.** Renewable energy service plan is provided as follows:				
	(1)	Builder selects a renewable energy service plan provided by the local electrical utility for interim (temporary) electric service, or purchases renewable energy certificates (RECs) to cover electricity used. The builder's local administrative office has renewable energy service or has otherwise been paired with RECs. Green-ecertified (or equivalent) is required for renewable electricity purchases.	**1**	0	☐	
	(2)	The buyer of the building selects one of the following renewable energy service plans provided by the utility prior to occupancy of the building with a minimum two-year commitment.		0		
	(a)	less than half of the dwelling's projected electricity and gas use is provided by renewable energy	**1**			
	(b)	half or more of the of the dwelling's projected electricity and gas use is provided by renewable energy	**2**			
706.3		**706.3 Smart Appliances and Systems.** Smart appliances and systems are installed as follows:		0		
		Three to five smart appliances installed	**1**			
		Six or more smart appliances installed	**2**			
		(Items (7) and (8) are permitted to count as two appliances each for the purpose of awarding points.) **(where points awarded in Section 706.3, points shall not be awarded in Section 706.7 and 706.9)**				
	(1)	Refrigerator			☐	
	(2)	Freezer			☐	
	(3)	Dishwasher			☐	
	(4)	Clothes Dryer			☐	
	(5)	Clothes Washer			☐	
	(6)	Room Air Conditioner			☐	
	(7)	HVAC Systems			☐	
	(8)	Service Hot Water Heating Systems			☐	
706.4		**706.4 Pumps.**				
706.4.1		**706.4.1** Pool, spa, and water features equipped with filtration pumps as follows:				
	(1)	Electronically controlled variable-speed pump(s) is installed (full load efficiency of 90 percent or greater).	**1**	0	☐	
	(2)	Electronically controlled variable-speed pump(s) is installed (full load efficiency of 90 percent or greater) in a pool	**3**	0	☐	will this be added?
706.4.2		**706.4.2** Sump pump(s) with electrically commutated motors (ECMs) or permanent split capacitor (PSC) motors is installed (full load efficiency of 90 percent or greater).	**1**	0	☐	

706.5		**706.5 On-site renewable energy system.** One of the following options is implemented				
	(1)	Building is Solar-Ready in compliance with IECC Appendix A Solar Ready Provisions.	**1**	0	☐ kW per 154 units:	
	(2)	An on-site renewable energy system(s) is installed on the property.	**2 per kW**	0	kWh of strg. per 154 units	
	(3)	An on-site renewable energy system(s) and a battery energy storage system are installed on the property. **Points awarded shall not be combined with points for renewable energy in another section of this chapter. Points shall not be awarded for solar thermal or geothermal systems that provide space heating, space cooling, or water heating, points for these systems are awarded in § 703. Where onsite renewable energy is included in § 702 Performance Path or 704 ERI Target Path, § 706.5 shall not be awarded. The solar-ready zone roof area in #1 is area per dwelling unit. Points in item #2 and #3 shall be divided by the number of dwelling**	**2 per kW, 1 per 2 kWh**	0		
		Multifamily Building Note: *Conditioned common area and non-residential space is excluded for the purpose of calculating number of units.*				
706.6		**706.6 Parking garage efficiency.** Structured parking garages are designed to require no mechanical ventilation for fresh air requirements.	**2**	0	☐	
706.7		**706.7 Grid-interactive electric thermal storage system.** A grid-interactive electric thermal storage system is installed.				
	(1)	Grid-Interactive Water Heating System	**1**	0	☐	
	(2)	Grid-Interactive Space Heating and cooling System **(where points awarded in Section 706.7, points shall not be awarded in Section 706.3 and 706.9)**	**1**	0	☐	
706.8		**706.8 Electrical vehicle charging station.** A Level 2 (208/240V 40-80 amp) or Level 3 electric vehicle charging station is installed on the building site. (Note: Charging station shall not be included in the building energy consumption.)	**2**	0	☐	Will level 2 EV charger be installed
706.9		**706.9 CNG vehicle fueling station.** A CNG vehicle residential fueling appliance is installed on the building site. The CNG fueling appliances shall be listed in accordance with ANSI/CSA NGV 5.1 and installed in accordance to the appliance manufacturer's installation instructions. (Note: The fueling appliance shall not be included in the building energy consumption.)	**1**	0	☐	
706.10		**706.10 Automatic demand response.** Automatic demand response system is installed that curtails energy usage upon a signal from the utility or an energy service provider is installed. **(where points awarded in Section 706.10, points shall not be awarded in Section 706.3 and 706.7)**	**1**	0	☐	
706.11		**706.11 Grid-interactive battery storage system.** A grid-interactive battery storage system of not less than 6 kWh of available capacity is installed.	**2**	0	☐	
706.12		**706.12 Smart ventilation.** A whole-building ventilation systems is installed with automatic ventilation controls to limit ventilation during periods of extreme temperature, extreme humidity, and/or during times of peak utility loads and is in accordance with the specifications of ASHRAE Standard 62.2-2010 Section 4.	**1**	0	☐	
706.13		**706.13 Alternative refrigerant.** Use of the following in mechanical space cooling systems for dwellings.		0		
	(1)	Use alternative refrigerant with a GWP < 1000	**1**			
	(2)	Do not use refrigerants	**2**			
706.14		**706.14 Third-party utility benchmarking service.**				
	(1)	For a multifamily building, the owner has contracted with a third-party utility benchmarking service with at least five (5) years of experience in utility data management and analysis to perform a monthly analysis of whole-building energy and water consumption for a minimum of 1 year.	**3**	0	☐	
	(2)	The building owner commits to reporting energy data using U.S. Environmental Protection Agency's ENERGY STAR Portfolio Manager for a minimum of three years.	**1**	0	☐	
706.15		**706.15 Entryway air seal.** For multifamily buildings, where not required by the building or energy code, to slow the movement of unconditioned air from outdoors to indoors at the main building entrance, the following is installed:				
	(1)	Building entry vestibule.	**2**	0	☐	
	(2)	Revolving entrance doors.	**2**	0	☐	
END OF CHAPTER 7						CLICK TO PROCEED TO CHAPTER 8 >>

	Current Chapter level: Silver **Total Points: 57**				
	Points away from: Bronze: 0, Silver: 0, Gold: 10, Emerald: 35				
	Add'l pts earned above: Bronze: 32, Silver: 18, Gold: 0, Emerald: 0				
	Total Chapter Points needed for: Bronze: 25, Silver: 39, Gold: 67, Emerald: 92				
	Revision Date: 2/28/2024				
Coding	Practice #	Chapter 8: Water Efficiency	Points Available	Points Claimed	Status	Notes
	801	**INDOOR AND OUTDOOR WATER USE**				
	801.0	**801.0 Intent.** Implement measures that reduce indoor and outdoor water usage. Implement measures that include collection and use of alternative sources of water. Implement measures that treat water on site.				
	801.1	**801.1 Mandatory requirements.** The building shall comply with Section 802 (Prescriptive Path) and 803 (Innovative Practices) or Section 804 (Performance Path). Points from Section 804 (Performance Path) shall not be combined with points from Section 802 (Prescriptive Path) or Section 803 (Innovative Practices). The mandatory provisions of Section 802 (Prescriptive Path) are required when using the Water Rating Index of Section 804 (Performance Path) for Chapter 8 Water Efficiency compliance.			Prescriptive Path	
	802	**PRESCRIPTIVE PATH**				
	802.1	**802.1 Indoor hot water usage.** Indoor hot water supply system is in accordance with one of the practices listed in items (1) through (5). The maximum water volume from the source of hot water to the termination of the fixture supply is determined in accordance with Tables 802.1(1) or 802.1(2). The maximum pipe length from the source of hot water to the termination of the fixture supply is 50 feet.		0		
		(Where more than one water heater is used or where more than one type of hot water supply system, including multiple circulation loops, is used, points are awarded only for the system that qualifies for the minimum number of points.)				
		(Systems with circulation loops are eligible for points only if pumps are demand controlled. Circulation systems with timers or aquastats and constant-on circulation systems are not eligible to receive points.)				
		(Points awarded only if the pipes are insulated in accordance with Section 705.6.3.)				
		See Table 802.1(1)				
		See Table 802.1(2)				
	(1)	The maximum volume from the water heater to the termination of the fixture supply at furthest fixture is 128 ounces (1 gallon or 3.78 liters).	**8**			
	(2)	The maximum volume from the water heater to the termination of the fixture supply at furthest fixture is 64 ounces (0.5 gallon or 1.89 liters).	**12**			
	(3)	The maximum volume from the water heater to the termination of the fixture supply at furthest fixture is 32 ounces (0.25 gallon or 0.945 liters).	**20**			
	(4)	A demand controlled hot water priming pump is installed on the main supply pipe of the circulation loop and the maximum volume from this supply pipe to the furthest fixture is 24 ounces (0.19 gallons or 0.71 liters).	**24**			
	(a)	The volume in the circulation loop (supply) from the water heater or boiler to the branch for the furthest fixture is no more than 128 ounces (1 gallon or 3.78 liters).	**4 Additional**			
	(5)	A central hot water recirculation system is implemented in multifamily buildings in which the hot water line distance from the recirculating loop to the engineered parallel piping system (i.e., manifold system) is less than 30 feet (9,144 mm) and the parallel piping to the fixture fittings contains a maximum of 64 ounces (1.89 liters) (115.50 cubic inches) (0.50 gallons).	**9**			
	(6)	Tankless water heater(s) with at least 0.5 gallon (1.89 liters) of storage are installed, or a tankless water heater that ramps up to at least 110F within 5 seconds is installed. The storage may be internal or external to the tankless water heater.	**1 Additional**	0	☐	
	802.2	**802.2 Water-conserving appliances.** Energy Star or equivalent water-conserving appliances are installed.				
	(1)	dishwasher	**2**	2	☑	
	(2)	clothes washer, or	**13**	13	(2)	dishwasher will need to be ENERGY STAR for HUD-MIP requirements
	(3)	clothes washer with an Integrated Water Factor of 3.8 or less	**18**			
		NOTE: If multiple dishwashers and washing machines are installed, ALL instances must meet the above conditions to be awarded points.				
		Multifamily Building Note: Washing machines are installed in individual units or provided in common areas of multifamily buildings.				
	802.3	**802.3 Water usage metering.** Water meters are installed meeting the following:				
	(1)	Single-Family Buildings: Water Usage Metering:				
	(a)	Where not otherwise required by the local AHJ, installation of a meter for water consumed from any source associated with the building or building site.	**2 per unique meter**	0		
	(b)	Each water meter shall be capable of communicating water consumption data remotely for the dwelling unit occupant and be capable of providing daily data with electronic data storage and reporting capability that can produce reports for daily, monthly, and yearly water consumption. (Fire sprinkler systems are not required to be metered).	**2 per sensor package**	0		
	(2)	Multi-Family Buildings: Water Usage Metering:				
		(Points earned in Section 802.3(2) shall not exceed 50% of the total points earned for Chapter 8)	**Points Reduced**			
	(a)	Where not otherwise required by the local AHJ, installation of a meter for water consumed from any source associated with the building or building site.	**2 per unique use meter**	0		Will units be submetered?
	(b)	Each water meter shall be capable of communicating water consumption data remotely for the dwelling unit occupant and be capable of providing daily data with electronic data storage and reporting capability that can produce reports for daily, monthly, and yearly water consumption. (Fire sprinkler systems are not required to be metered).	**2 per sensor package**	0		
	802.4	**802.4 Showerheads.** Showerheads are in accordance with the following:			# of compartments:	
	(1)	The total maximum combined flow rate of all showerheads in a shower compartment with floor area of 2600 square inches or less is equal or less than 2.0 gpm. For each additional 1300 square inches or any portion thereof of shower compartment floor area, an additional 2.0 gpm combined showerhead flow rate is allowed. Showerheads shall comply with ASME A112.18.1/CSA B125.1 and shall meet the performance criteria of the U.S. EPA WaterSense Specification for showerheads. Showerheads shall be served by an automatic compensating valve that complies with ASSE 1016/ASME A112.1016/CSA B125.16 or ASME A112.18.1/CSA B125.1 and specifically designed to provide thermal shock and scald protection at the flow rate of the showerhead.	**4 for first compartment** **1 for each additional compartment in dwelling**	4	1 compartment	Needs to be a WaterSense Certified fixture
		(Points awarded per shower compartment. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)	**7 Max**			
	(2)	All shower compartments in the dwelling unit(s) or sleeping unit(s) and common areas meet the requirements of 802.4(1) and all showerheads are in accordance with one of the following:		6	(a)	1.8 GPM or less fixture
	(a)	maximum of 1.8 gpm	**6 Additional**			
	(b)	maximum of 1.5 gpm	**10 Additional**			
	(3)	Any shower control that can shut off water flow without affecting temperature is installed. **(Points awarded per shower control.)**	**1** **3 Max**	0		

802.5		**802.5 Faucets**				
802.5.1		**802.5.1** Install water-efficient lavatory faucets with flow rates not more than 1.5 gpm (5.68 L/m), tested in compliance with ASME A112.18.1/CSA B125.1 and meeting the performance criteria of the EPA WaterSense High-Efficiency Lavatory Faucet Specification:		7	1 fixture	Current using 1.5 gpm for lavs will this be 1.2 gpm?
					(3)	
	(1)	Flow rate ≤ 1.5 gpm (*all faucets in a bathroom are in compliance) **(Points awarded for each bathroom. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)**	**1 3 Max**			
	(2)	Flow rate ≤ 1.2 gpm (*all faucets in a bathroom are in compliance)	**2 (6 Max)**			
	(3)	Flow rate ≤ 1.5 gpm for all lavatory faucets in the dwelling unit(s) or sleeping unit(s)	**6 Additional**			
	(4)	Flow rate ≤ 1.5 gpm for all lavatory faucets in the dwelling unit(s), and at least one bathroom has faucets with flow rates ≤ 1.2 gpm	**8 Additional**			
	(5)	Flow rate ≤ 1.2 gpm for all lavatory faucets in the dwelling unit(s)	**12 Additional**			
802.5.2		**802.5.2** Water-efficient residential kitchen faucets are installed in accordance with ASME A112.18.1/CSA B125.1. Residential kitchen faucets may temporarily increase the flow above the maximum rate but not to exceed 2.2 gpm.		0		
	(1)	All residential kitchen faucets have a maximum flow rate of 1.8 gpm.	**3**			
	(2)	All residential kitchen faucets have a maximum flow rate of 1.5 gpm.	**1 Additional**			
802.5.3		**802.5.3** Self-closing valve, motion sensor, metering, or pedal-activated faucet is installed to enable intermittent on/off operation. **(Points awarded per fixture.)**	**1 3 Max**	0		
802.5.4		**802.5.4 Water closets and urinals.** Water closets and urinals are in accordance with the following:				
	(1)	Gold and emerald levels: All water closets and urinals are in accordance with Section 802.5.4.	**Met**			
	(2)	A water closet is installed with an effective flush volume of 1.28 gallons (4.85 L) or less in accordance with ASME A112.19.2/CSA B45.1 or ASME A112.19.14 as applicable. Tank-type water closets shall be in accordance with the performance criteria of the U.S. EPA WaterSense Specification for Tank-Type Toilets. **(Points awarded per fixture. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)**	**4 12 Max**	4	1 fixture	CST744EN model number for the commode spe'd as 1.28 gpf
	(3)	All water closets are in accordance with Section 802.5.4(2).	**13 Additional**	13	☑	
	(4)	All water closets are in accordance with Section 802.5.4(2) and one or more of the following are installed:				
	(a)	Water closets that have an effective flush volume of 1.2 gallons or less. **(Points awarded per toilet. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)**	**2 Additional 6 Max**	0		
	(b)	One or more urinals with a flush volume of 0.5 gallons (1.9L) or less when tested in accordance with ASME A112.19.2/CSA B45.1.	**2 Additional**	0	☐	
	(c)	One or more composting or waterless toilets and/or nonwater urinals. Nonwater urinals shall be tested in accordance with ASME A112.19.2/CSA B45.1.	**12 Additional**	0	☐	
802.6		**802.6 Irrigation systems**				
802.6.1		**802.6.1** Where an irrigation system is installed, an irrigation plan and implementation are executed by a qualified professional or equivalent.	**Mandatory**		Met	
802.6.2		**802.6.2** Irrigation sprinkler nozzles shall be tested according to ANSI standard ASABE/ICC 802-2014 Landscape Irrigation Sprinkler and Emitter Standard by an accredited third party laboratory.	**6**	0	☐	
802.6.3		**802.6.3** Drip irrigation is installed.				
	(1)	Drip irrigation is installed for all landscape beds.	**4**	0	☐	will this be done
	(2)	Subsurface drip is installed for all turf grass areas.	**4**	0	☐	
	(3)	Drip irrigation zones specifications show plant type by name and water use/need for each emitter (Points awarded only if specifications are implemented.)	**5**	0	☐	
802.6.4		**802.6.4** The irrigation system(s) is controlled by a smart controller or no irrigation is installed. **(Points are not additive.)**				
	(1)	Irrigation controllers shall be in accordance with the performance criteria of the EPA WaterSense program	**10**	0	☐	
	(2)	No irrigation is installed and a landscape plan is developed in accordance with Section 503.5, as applicable. NOTE: 5 Points must be taken in 503.5(1)-(7) for a Full Landscape Plan in order to receive points for 802.6.4(2).	**15**	0	☐	
802.6.5		**802.6.5 Commissioning and water use reduction for irrigation systems.** *[Points are not additive per each section.]*				
	(1)	All irrigation zones utilize pressure regulation so emission devices (sprinklers and drip emitters) operate at manufacturer's recommended operating pressure.	**3**	0	☐	
	(2)	Where dripline tubing is installed, a filter with mesh size in accordance with the manufacturer's recommendation is installed on all drip zones.	**3**	0	☐	
	(3)	Utilize spray bodies that incorporate an in-stem or external flow shut-off device.	**3**	0	☐	
	(4)	For irrigation systems installed on sloped sites, either an in-stem or external check valve is utilized for each spray body.	**3**	0	☐	
	(5)	Where an irrigation system is installed, a flow sensing device is installed to monitor and alert the controller when flows are outside design range.	**3**	0	☐	
802.7		**802.7 Rainwater collection and distribution.** Rainwater collection and distribution is provided.				
802.7.1		**802.7.1** Rainwater is used for irrigation in accordance with one of the following:		0		
	(1)	Rainwater is diverted for landscape irrigation without impermeable water storage	**5**			
	(2)	Rainwater is diverted for landscape irrigation with impermeable water storage in accordance with one of the following:				
	(a)	50 – 499 gallon storage capacity	**5**			
	(b)	500 – 2499 gallon storage capacity	**10**			
	(c)	2500 gallon or larger storage capacity (system is designed by a professional certified by The American Rainwater Catchment Systems Association or equivalent)	**15**			
	(d)	All irrigation demands are met by rainwater capture (documentation demonstrating the water needs of the landscape is provided and the system is designed by a professional certified by The American Rainwater Catchment Systems Association or equivalent).	**25**			
802.7.2		**802.7.2** Rainwater is used for indoor domestic demand as follows. The system is designed by a professional certified by The American Rainwater Catchment Systems Association or equivalent.		0		
	(1)	Rainwater is used to supply an indoor appliance or fixture for any locally approved use. **(Points awarded per appliance or fixture.)**	**5 15 Max**			
	(2)	Rainwater provides for total domestic demand.	**25**		☐	

802.8		**802.8 Sediment filters.** Water filter is installed to reduce sediment and protect plumbing fixtures for the whole building or the entire dwelling unit.	1	0	☐	
802.9		**802.9 Water treatment devices.**				
802.9.1		**802.9.1** Water Softeners shall not be installed where the supplied water hardness is less than 8.0 grains per gallon measured as total calcium carbonate equivalents. Water softeners shall be listed to NSF 44 and a rated salt efficiency of 3400 grains of total hardness per 1.0 pound of salt based on sodium chloride equivalency. Devices shall not discharge more than 4.0 gallons of water per 1000 grains of hardness removed during the service or recharge cycle.		5	(1)	
	(1)	No water softener.	5			
	(2)	Water softener installed to supply softened water only to domestic water heater.	2			
802.9.2		**802.9.2** Reverse Osmosis (R/O) water treatment systems shall be listed to NSF 58 and shall include automatic shut-off valve to prevent water discharge when storage tank is full.		3	(1)	
	(1)	No R/O system.	3			
	(2)	Combined capacity of all R/O systems does not exceed 0.75 gallons.	1			
802.10		**802.10 Pools and spas.**				
802.10.1		**802.10.1** Pools and Spas with water surface area greater than 36 square feet and connected to a water supply shall have a dedicated meter to measure the amount of water supplied to the pool or spa.	Mandatory		Met	Pool needs to be submetered
	(1)	Automated motorized non-permeable pool cover that covers the entire pool surface.	10	0	☐	
803 INNOVATIVE PRACTICES						
803.1		**803.1 Reclaimed, gray, or recycled water**. Reclaimed, gray, or recycled water is used as permitted by applicable code.		0		
		(Points awarded for either Section 803.1(1) or 803.1(2), not both.)				
		(Points awarded for either Section 803.6 or 803.1, not both.)				
	(1)	each water closet flushed by reclaimed, gray, or recycled water	5			
		(Points awarded per fixture or appliance.)	20 Max			
	(2)	irrigation from reclaimed, gray, or recycled water on-site	10		☐	
803.2		**803.2 Reclaimed water, graywater, or rainwater pre-piping.** Reclaimed, graywater, or rainwater systems are rough plumbed (and permanently marked, tagged or labeled) into buildings for future use.	3 per roughed in system	0	# of systems:	
803.3		**803.3 Automatic leak detection and control devices.** One of the following devices is installed. Where a fire sprinkler system is present, ensure the device will be installed to not interfere with the operation of the fire sprinkler system.	2	0		
	(1)	automatic water leak detection and control devices				
	(2)	automatic water leak detection and shutoff devices				
803.4		**803.4 Engineered biological system or intensive bioremediation system.** An engineered biological system or intensive bioremediation system is installed and the treated water is used on site. Design and implementation are approved by appropriate regional authority.	20	0	☐	
803.5		**803.5 Recirculating humidifier.** Where a humidifier is required, a recirculating humidifier is used in lieu of a traditional "flow through" type.	1	0	☐	
803.6		**803.6 Advanced wastewater treatment system.** Advanced wastewater (aerobic) treatment system is installed and treated water is used on site.	20	0	☐	
		(Points awarded for either Section 803.6 or 803.1, not both.)				
804 PERFORMANCE PATH						
804.1		**804.1 Performance Path.** The index score for the Performance Path shall be calculated in accordance with Appendix D Water Rating Index (WRI) or equivalent methodology.	None		WRI	
804.2		**804.2 Water efficiency rating levels.** In lieu of threshold levels for Chapter 8 in Table 303, rating levels for Section 804.1 are in accordance with Table 804.2.				
804.3		**804.3 Water efficiency NGBS points equivalency.** The additional points for use with Table 303 from the Chapter 8 Water Efficiency Category are determined in accordance with equation 804.3.		0		
		Equation 804.3				
		NGBS = WRI x (-2.29) + 181.7				
END OF CHAPTER 8						CLICK TO PROCEED TO CHAPTER 9 >>

		Current Chapter level: Silver **Total Points: 56**				
		Points away from: Bronze: 0, Silver: 0, Gold: 13, Emerald: 41				
		Add'l pts earned above: Bronze: 31, Silver: 14, Gold: 0, Emerald: 0				
		Total Chapter Points needed for: Bronze: 25, Silver: 42, Gold: 69, Emerald: 97				
		Revision Date: 2/28/2024				
Coding	Practice #	Chapter 9: Indoor Environmental Quality	Points Available	Points Claimed	Status	Notes
		901 POLLUTANT SOURCE CONTROL				
	901.0	**901.0 Intent.** Pollutant sources are controlled.				
	901.1	**901.1 Space and water heating options**				
	901.1.1	**901.1.1** Natural draft furnaces, boilers, or water heaters are not located in conditioned spaces, including conditioned crawlspaces, unless located in a mechanical room that has an outdoor air source and is sealed and insulated to separate it from the conditioned space(s). **(Points are awarded only for buildings that use natural draft combustion space or water heating equipment.)**	**5**	0	☐	
	901.1.2	**901.1.2** Air handling equipment or return ducts are not located in the garage, unless placed in isolated, air-sealed mechanical rooms with an outside air source. Not available if there is no attached garage	**5**	0	☐	
	901.1.3	**901.1.3** The following combustion space heating or water heating equipment is installed within conditioned space:				
	(1)	all furnaces or all boilers		0		
	(a)	power vent furnace(s) or boiler(s)	**3**			
	(b)	direct vent furnace(s) or boiler(s)	**5**			
	(2)	all water heaters		0		
	(a)	power vent water heater(s)	**3**			
	(b)	direct vent water heater(s)	**5**			
	901.1.4	**901.1.4** Gas-fired fireplaces and direct heating equipment is listed and is installed in accordance with the NFPA 54, ICC IFGC, or the applicable local gas appliance installation code. Gas-fired fireplaces within dwelling units or sleeping units and direct heating equipment are vented to the outdoors. Alcohol burning devices and kerosene heaters are vented to the outdoors.	**Mandatory**		N/A	
	901.1.5	**901.1.5** Natural gas and propane fireplaces are direct vented, have permanently fixed glass fronts or gasketed doors, and comply with CSA Z21.88/CSA 2.33 or CSA Z21.50b/CSA 2.22b.	**7**	0	☐	
	901.1.6	**901.1.6** The following electric equipment is installed:		5	(2)	
	(1)	heat pump air handler in unconditioned space	**2**			
	(2)	heat pump air handler in conditioned space	**5**			
	901.2	**901.2 Solid fuel-burning appliances**				
	901.2.1	**901.2.1** Solid fuel-burning fireplaces, inserts, stoves and heaters are code compliant and are in accordance with the following requirements:				
	(1)	Site-built masonry wood-burning fireplaces use outside combustion air and include a means of sealing the flue and the combustion air outlets to minimize interior air (heat) loss when not in operation.	**N/A** **4**	0		
	(2)	Factory-built, wood-burning fireplaces are in accordance with the certification requirements of UL 127 and are an EPA Phase 2 Emission Level Qualified Model.	**N/A** **6**	0		
	(3)	Wood stove and fireplace inserts, as defined in UL 1482 Section 3.8, are in accordance with the certification requirements of UL 1482 and are in accordance with the emission requirements of the EPA Certification and the State of Washington WAC 173-433-100(3).	**N/A** **6**	0		
	(4)	Pellet (biomass) stoves and furnaces are in accordance with ASTM E1509 or are EPA certified.	**N/A** **6**	0		
	(5)	Masonry heaters are in accordance with the definitions in ASTM E1602 and ICC IBC Section 2112.1.	**N/A** **6**	0		
	901.2.2	**901.2.2** Fireplaces, woodstoves, pellet stoves, or masonry heaters are not installed.	**6**	6	☑	
	901.3	**901.3 Garages.** Garages are in accordance with the following:				
	(1)	Attached garage				
	(a)	Doors installed in the common wall between the attached garage and conditioned space are tightly sealed and gasketed.	**N/A** **2**	0		
	(b)	A continuous air barrier is provided separating the garage space from the conditioned living spaces.	**N/A** **2**	0		
	(c)	For one- and two-family dwelling units, a 100 cfm (47 L/s) or greater ducted or 70 cfm (33 L/s) cfm or greater unducted wall exhaust fan is installed and vented to the outdoors and is designed and installed for continuous operation or has controls (e.g., motion detectors, pressure switches) that activate operation for a minimum of 1 hour when either human passage door or roll-up automatic doors are operated. For ducted exhaust fans, the fan airflow rating and duct sizing are in accordance with ASHRAE Standard 62.2-2007 Section 7.3.	**8**	0	☐	
	(2)	A carport is installed, the garage is detached from the building, or no garage is installed.	**10**	10	☑	
	901.4	**901.4** Wood materials. A minimum of 85 percent of material within a product group (i.e., wood structural panels, countertops, composite trim/doors, custom woodwork, and/or component closet shelving) is manufactured in accordance with the following:	**10 Max**	0		
	(1)	Structural plywood used for floor, wall, and/or roof sheathing is compliant with DOC PS 1 and/or DOC PS 2. OSB used for floor, wall, and/or roof sheathing is compliant with DOC PS 2. The panels are made with moisture-resistant adhesives. The trademark indicates these adhesives as follows: Exposure 1 or Exterior for plywood, and Exposure 1 for OSB. NOTE: If "N/A" is selected, please explain in the Notes area.	**Mandatory**		Met	
		Countertops				
		Composite trim/doors				
		Custom woodwork				
		Component closet shelving				
	(2)	Particleboard and MDF (medium density fiberboard) is manufactured and labeled in accordance with CPA A208.1 and CPA A208.2, respectively.	**2**			
	(3)	Hardwood plywood in accordance with HPVA HP-1.	**2**			
	(4)	Particleboard, MDF, or hardwood plywood is in accordance with CPA 4.	**3**			
	(5)	Composite wood or agrifiber panel products contain no added urea-formaldehyde or are in accordance with the CARB *Composite Wood Air Toxic Contaminant Measure Standard* .	**4**			
	(6)	Non-emitting products.	**4**			
	901.5	**901.5 Cabinets.** A minimum of 85 percent of installed cabinets are in accordance with one or both of the following: **(Where both of the following practices are used, only 3 points are awarded.)**				
	(1)	All parts of the cabinet are made of solid wood or non-formaldehyde emitting materials such as metal or glass.	**5**	0	☐	
	(2)	The composite wood used in wood cabinets is in accordance with CARB *Composite Wood Air Toxic Contaminant Measure Standard* or equivalent as certified by a third-party program such as, but not limited to, those in Appendix B.	**3**	0	☐	
	901.6	**901.6 Carpets.** Wall-to-wall carpeting is not installed adjacent to water closets and bathing fixtures.	**Mandatory**		☑	

901.7		**901.7 Floor materials.** The following types of finished flooring materials are used. The materials have emission levels in accordance with CDPH/EHLB Standard Method v1.1. Product is tested by a laboratory with the CDPH/EHLB Standard Method v1.1 within the laboratory scope of accreditation to ISO/IEC 17025 and certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	**1 8 Max**	0		
		(Points are awarded for every 10% of conditioned floor space using one of the below materials.)			actual %:	
	(1)	Hard surface flooring: Prefinished installed hard-surface flooring is installed. Where post-manufacture coatings or surface applications have not been applied, the following hard surface flooring types are deemed to comply with the emission requirements of this practice:				need flooring product spec
		(a) Ceramic tile flooring				
		(b) Organic-free, mineral-based flooring				
		(c) Clay masonry flooring				
		(d) Concrete masonry flooring				
		(e) Concrete flooring				
		(f) Metal flooring			actual %'s:	
	(2)	Carpet meeting and carpet cushion not meeting the emission limits is installed.				
	(3)	Carpet and carpet cushion meeting the emission limits is installed. **(When carpet cushion meeting the emission limits of the practice is also installed, the percentage of compliant carpet area is calculated at 1.33 times the actual installed area.)**				
901.8		**901.8 Wall coverings.** A minimum of 10 percent of the interior wall surfaces are covered and a minimum of 85 percent of wall coverings are in accordance with the emission concentration limits of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	**4**	0	☐	
901.9		**901.9 Interior architectural coatings.** A minimum of 85 percent of the interior architectural coatings are in accordance with either Section 901.9.1 or Section 901.9.3, not both. A minimum of 85 percent of architectural colorants are in accordance with Section 901.9.2.				
901.9.1		**901.9.1** Site-applied interior architectural coatings, which are inside the water proofing envelope, are in accordance with one or more of the following:	**5**	5		
	(1)	Zero VOC as determined by EPA Method 24 (VOC content is below the detection limit for the method)			☐	
	(2)	GreenSeal GS-11			☐	
	(3)	CARB *Suggested Control Measure for Architectural Coatings* (see Table 901.9.1). See Table 901.9.1			☑	
901.9.2		**901.9.2** Architectural coating colorant additive VOC content is in accordance with Table 901.9.2. **(Points for 901.9.2 are awarded only if base architectural coating is in accordance with 901.9.1.)** See Table 901.9.2	**1**	0	☐	
901.9.3		**901.9.3** Site-applied interior architectural coatings, which are inside the waterproofing envelope, are in accordance with the emission levels of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 in its scope of accreditation. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those found in Appendix B.	**8**	0	☐	
901.10		**901.10 Interior adhesives and sealants.** A minimum of 85 percent of site-applied adhesives and sealants located inside the waterproofing envelope are in accordance with one of the following, as applicable.		5		
	(1)	The emission levels are in accordance with CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those found in Appendix B.	**8**		☐	
	(2)	GreenSeal GS-36.	**5**		☐	
	(3)	SCAQMD Rule 1168 in accordance with Table 901.10(3), excluding products that are sold in 16 ounce containers or less and are regulated by the California Air Resources Board (CARB) Consumer Products Regulations. See Table 901.10(3)	**5**		☑	
901.11		**901.11 Insulation.** Emissions of 85 percent of wall, ceiling, and floor insulation materials are in accordance with the emission levels of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation. Insulation is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	**4**	4	☑	
901.12		**901.12 Furniture and Furnishings.** In a multifamily building, all furniture in common areas shall have VOC emission levels in accordance with ANSI/BIFMA e3-Furniture Sustainability Standard sections 7.6.1 and 7.6.2, tested in accordance with ANSI/BIFMA Standard Method M7.1.	**2**	0	☐	
901.13		**901.13 Carbon monoxide (CO) alarms.** A carbon monoxide (CO) alarm is provided in accordance with the IRC Section R315.	**Mandatory**		Met	
901.14		**901.14 Building entrance pollutants control.** Pollutants are controlled at all main building entrances by one of the following methods:		0		
	(1)	Exterior grilles or mats are installed in a fixed manner and may be removable for cleaning.	**1**		☐	
	(2)	Interior grilles or mats are installed in a fixed manner and may be removable for cleaning.	**1**		☐	
901.15		**901.15 Non-smoking areas.** Environmental tobacco smoke is minimized by one or more of the following:				
	(1)	All interior common areas of a multifamily building are designated as non-smoking areas with posted signage.	**1**	0	☐	
	(2)	Exterior smoking areas of a multifamily building are designated with posted signage and located a minimum of 25 feet from entries, outdoor air intakes, and operable windows.	**1**	0	☐	

902 POLLUTANT CONTROL

902.0		**902.0 Intent.** Pollutants generated in the building are controlled.				
902.1		**902.1 Spot ventilation.**				
902.1.1		**902.1.1** Spot ventilation is in accordance with the following:				
	(1)	Bathrooms are vented to the outdoors. The minimum ventilation rate is 50 cfm (23.6 L/s) for intermittent operation or 20 cfm (9.4 L/s) for continuous operation in bathrooms.	**Mandatory**		☑	
	(a)	A window complying with IRC Section R303.3 is provided in addition to mechanical ventilation.	**1**	0	☐	
	(2)	Clothes dryers (except listed and labeled condensing ductless dryers) are vented to the outdoors.	**Mandatory**		Met	
	(3)	Kitchen exhaust units and/or range hoods are ducted to the outdoors and have a minimum ventilation rate of 100 cfm (47.2 L/s) for intermittent operation or 25 cfm (11.8 L/s) for continuous operation.	**8**	0	☐	
902.1.2		**902.1.2** Bathroom and/or laundry exhaust fan is provided with an automatic timer and/or humidistat:	**11 Max**	0	# of timers:	
	(1)	for first device	**5**		# of humidistats:	
	(2)	for each additional device	**2**			
902.1.3		**902.1.3** Kitchen range, bathroom, and laundry exhaust are verified to air flow specification. Ventilation airflow at the point of exhaust is tested to a minimum of:	**8**	0	☐	
	(a)	100 cfm (47.2 L/s) intermittent or 25 cfm (11.8 L/s) continuous for kitchens, and				
	(b)	50 cfm (23.6 L/s) intermittent or 20 cfm (9.4 L/s) continuous for bathrooms and/or laundry				
902.1.4		**902.1.4** Exhaust fans are ENERGY STAR, as applicable.	**12 Max**	3		Panosonic ES fan, low sone per Mech Engineer
	(1)	ENERGY STAR, or equivalent, fans operating above 1 sone **(Points awarded per fan.)**	**2**		# of fans:	
	(2)	ENERGY STAR, or equivalent, fans operating at or below 1 sone **(Points awarded per fan.)**	**3**		1 fan(s)	
902.1.5		**902.1.5** Fenestration in spaces other than those identified in 902.1.1 through 902.1.4 are designed for stack effect or cross-ventilation in accordance with all of the following:	**3**	0		
	(1)	Operable windows, operable skylights, or sliding glass doors with a total area of at least 15 percent of the total conditioned floor area are provided.			☐	
	(2)	Insect screens are provided for all operable windows, operable skylights, and sliding glass doors.			☐	
	(3)	A minimum of two operable windows or sliding glass doors are placed in adjacent or opposite walls. If there is only one wall surface in that space exposed to the exterior, the minimum windows or sliding glass doors may be on the same wall.			☐	
902.1.6		**902.1.6 Ventilation for Multifamily Common Spaces.** Systems are implemented and are in accordance with the specifications of ASHRAE 62.1 and an explanation of the operation and importance of the ventilation system is included in 1002.1 and 1002.2 of NGBS.	**3**	0	☐	
902.2		**902.2 Building ventilation systems.**				
902.2.1		**902.2.1** One of the following whole building ventilation systems is implemented and is in accordance with the specifications of ASHRAE Standard 62.2-2010 Section 4 and an explanation of the operation and importance of the ventilation system is **included in either 1001.1(9) or 1002.2(11)**.	**N/A**	0		May need smart switchs on the bath fans if following NGBS prescriptive path. Currently following the ERI path and not required if the unit ACH is 5 or great
	(1)	exhaust or supply fan(s) ready for continuous operation and with appropriately labeled controls	**3**			
	(2)	balanced exhaust and supply fans with supply intakes located in accordance with the manufacturer's guidelines so as to not introduce polluted air back into the building	**6**			
	(3)	heat-recovery ventilator	**7**			
	(4)	energy-recovery ventilator	**8**			
	(5)	Ventilation air is preconditioned by a system not specified above	**10**			
902.2.2		**902.2.2** Ventilation airflow is tested to achieve the design fan airflow in accordance with ANSI/RESNET/ICC 380 and Section 902.2.1.	**4**	0	☐	
902.2.3		**902.2.3** MERV filters 8 to 13 are installed on central forced air systems and are accessible. Designer or installer is to verify that the HVAC equipment is able to accommodate the greater pressure drop of MERV 8 to 13 filters.	**2**	0	☐	
902.2.4		**902.2.4** MERV filters 14 or greater are installed on central forced air systems and are accessible. Designer or installer is to verify that the HVAC equipment is able to accommodate the greater pressure drop of the filter used.	**3**	0	☐	

902.3		**902.3 Radon reduction measures.** Radon reduction measures are in accordance with ICC IRC Appendix F or 902.3.1. Radon Zones as identified by the AHJ or, if the zone is not identified by the AHJ, as defined in Figure 9(1).	Mandatory		ICC IRC F	At minimum a passive radon system needs to be installed. A select number of units will need to be tested and if radon is found above 4 pCi/L the system will need to be activated.
	(1)	Buildings located in Zone 1		0		
	(a)	a passive radon system is installed	Mandatory			
	(b)	an active radon system is installed	12			
	(2)	Buildings located in Zone 2 or Zone 3		0		
	(a)	a passive radon system is installed	6			
	(b)	an active radon system is installed	12			
902.3.1		**902.3.1 Radon reduction option.** This option requires section 902.3.1.1 through 902.3.1.7.				
902.3.1.1		**902.3.1.1 Soil-gas barriers and base course.** A base course in accordance with Section 506.2.2 of the IRC shall be installed below slabs and foundations. There shall be a continuous gas-permeable base course under each soil-gas retarder that is separated by foundation walls or footings. Between slabs and the base course, damp proofing or water proofing shall be installed in accordance with Section 406 of the IRC. Punctures, tears and gaps around penetrations of the soil-gas retarder shall be repaired or covered with an additional soil-gas retarder. The soil-gas retarder shall be a continuous6-mil (0.15 mm) polyethylene or an approved equivalent.				
902.3.1.2		**902.3.1.2 Soil gas collection.** There shall be an unobstructed path for soil gas flow between the void space installed in the base course and the vent through the roof. Soil gases below the foundation shall be collected by a perforated pipe with a diameter of not less than 4 inches (10 cm) and not less than 5 feet (1.5 m) in total length. A tee fitting or equivalent method shall provide two horizontal openings to the radon collection. The tee fitting shall be designed to prevent clogging of the radon collection path. Alternately the soil gas collection shall be by approved radon collection mats or an equivalent approved method.				
902.3.1.3		**902.3.1.3 Soil gas entry routes.** Openings in slabs, soil-gas retarders, and joints such as, but not limited to, plumbing, ground water control systems, soil-gas vent pipes, piping and structural supports, shall be sealed against air leakage at the penetrations. The sealant shall be a polyurethane caulk, expanding foam or other approved method. Foundation walls shall comply with Section 103.2.3 of the IRC. Sumps shall be sealed in accordance with Section 103.2.2 of the IRC. Sump pits and sump lids intended for ground water control shall not be connected to the sub-slab soil-gas exhaust system.				
902.3.1.4		**902.3.1.4 Soil gas vent.** A gas-tight pipe vent shall extend from the soil gas permeable layer though the roof. The vent pipe size shall not be reduced at any location as it goes from gas collection to the roof. Exposed and visible interior vent pipes shall be identified with not less than one label reading "Radon Reduction System" on each floor and in habitable attics.				
902.3.1.5		**902.3.1.5 Vent pipe diameter.** The minimum vent pipe diameter shall be as specified in Table 902.3.2.5.				
902.3.1.6		**902.3.1.6 Multiple vented areas.** In dwellings where interior footings or other barriers separate the soil-gas permeable layer, each area shall be fitted with an individual vent pipe. Vent pipes shall connect to a single vent that terminates above the roof or each individual vent pipe shall terminate separately above the roof.				
902.3.1.7		**902.3.1.7 Fan.** Each sub-slab soil-gas exhaust system shall include a fan, or dedicated space for the post-construction installation of a fan. The electrical supply for the fan shall be located within 6 feet (1.8 m) of the fan. Fan is not required to be on a dedicated circuit.				
902.3.2		**902.3.2 Radon testing.** Radon testing is mandatory for Zone 1.	Mandatory			
		Exceptions:			Exception:	
		(2) Testing is not mandatory where the occupied space is located above an unenclosed open space.			☐	
	(1)	Testing specifications. Testing is performance as specified in (a) through (j).	8	8	☑	3 pCi/L used as a place holder
	(a)	Testing is performed after the residence passes its airtightness test.			Test results (pCi/L):	
	(b)	Testing is performed after the radon control system installation is complete. If the system has an active fan, the residence shall be tested with the fan operating.			3.0 pCi/L	
	(c)	Testing is performed at the lowest level within a dwelling unit which will be occupied, even if the space is not finished.				
	(d)	Testing is not performed in a closet, hallway, stairway, laundry room, furnace room, kitchen or bathroom.				
	(e)	Testing is performed with a commercially available test kit or with a continuous radon monitor that can be calibrated. Testing shall be in accordance with the testing device manufacturer's instructions.				
	(f)	Testing shall be performed by the builder, a registered design professional, or an approved third party.				
	(g)	Testing shall extend at least 48 hours or to the minimum specified by the manufacturer, which ever is longer.				
	(h)	Written radon test results shall be provided by the test lab or testing party. Written test results shall be included with construction documents.				
	(i)	An additional pre-paid test kit shall be provided for the homeowner to use when they choose. The test kit shall include mailing or emailing the results from the testing lab to the homeowner.				
	(j)	Where the radon test result is 4 pCi/L or greater, the fan for the radon vent pipe shall be installed.				
	(2)	Testing results. A radon test done in accordance with 902.3.1 and completed before occupancy receives a results of 2 pCi/L or less.	6	0		
902.4		**902.4 HVAC system protection.** One of the following HVAC system protection measures is performed.	3	3		
	(1)	HVAC supply registers (boots), return grilles, and rough-ins are covered during construction activities to prevent dust and other pollutants from entering the system.			☐	
	(2)	Prior to owner occupancy, HVAC supply registers (boots), return grilles, and duct terminations are inspected and vacuumed. In addition, the coils are inspected and cleaned and the filter is replaced if necessary.			☑	
	(3)	If HVAC systems are to be operated, during construction, all return grilles have a temporary MERV 8 or higher filter installed in a manner ensuring no leakage around the filter.			☐	
902.5		**902.5 Central vacuum systems.** Central vacuum system is installed and vented to the outside.	3	0	☐	
902.6		**902.6 Living space contaminants.** The living space is sealed in accordance with Section 701.4.3.1 to prevent unwanted contaminants.	Mandatory		☑	
903 MOISTURE MANAGEMENT: VAPOR, RAINWATER, PLUMBING, HVAC						
903.0		**903.0 Intent.** Moisture and moisture effects are controlled.				
903.1		**903.1 Plumbing.** Plumbing is in accordance with one of the following.		2	(1)	
	(1)	Cold water pipes in unconditioned spaces are insulated to a minimum of R-4 with pipe insulation or other covering that adequately prevents condensation.	2			
	(2)	Plumbing is not installed in unconditioned spaces.	5			
903.2		**903.2 Duct insulation.** Ducts are in accordance with one of the following.		0		
	(1)	All HVAC ducts, plenums, and trunks are located in conditioned space.	1			
	(2)	All HVAC ducts, plenums, and trunks are in conditioned space. All HVAC ducts are insulated to a minimum of R4.	3			
903.3		**903.3 Relative humidity.** In climate zones 1A, 2A, 3A, 4A, and 5A, equipment is installed to maintain relative humidity (RH) at or below 60 percent using one of the following:	7	0		
	(1)	additional dehumidification system(s)			☐	
	(2)	central HVAC system equipped with additional controls to operate in dehumidification mode			☐	

904 INDOOR AIR QUALITY

904.0		**904.0 Intent.** IAQ is protected by best practices to control ventilation, moisture, pollutant sources and sanitation.				
904.1		**904.1 Indoor Air Quality (IAQ) During Construction.** Wood is dry before close-in (602.1.7.1(3)), materials comply with emission criteria (901.4- 901.11), sources of water infiltration or condensation observed during construction have been eliminated, accessible interior surfaces are dry and free of visible suspect growth (per ASTM D7338-10 section 6.3), and water damage (per ASTM D7338-10 section 7.4.3).	**2**	2	☑	
904.2		**904.2 Indoor Air Quality (IAQ) Post Completion.** Verify there are no moisture, mold, and dust issues per 602.1.7.1(3), 901.4-901.11, ASTM D7338 Section 6.3, and ASTM D7338 Section 7.4.3.	**3**	3	☑	
904.3		**904.3 Microbial growth & moisture inspection and remediation.** A visual inspection is performed to confirm the following:				
	(1)	Verify that no visible signs of discoloration and microbial growth on ceilings, walls or floors, or other building assemblies Or If minor microbial growth is observed (less than within a total area of 25 square feet) in homes or multifamily buildings, reference EPA Document 402-K-02-003 (A Brief Guide to Mold, Moisture, and Your Home) for guidance on how to properly remediate the issue. If microbial growth is observed, on a larger scale in homes or multifamily buildings (greater than 25 sq ft), reference EPA document 402-k-01-001 (Mold Remediation in Schools and Commercial Buildings) for guidance on how to properly remediate the issue.	**Mandatory**		☑	
	(2)	Verify that there are no visible signs of water damage or pooling. If signs of water damage or pooling are observed, verify that the source of the leak has been repaired, and that damaged materials are either properly dried or replaced as needed.	**Mandatory**		☑	

905 INNOVATIVE PRACTICES

905.1		**905.1 Humidity monitoring system.** A humidity monitoring system is installed with a mobile base unit that displays readings of temperature and relative humidity. The system has a minimum of two remote sensor units. One remote sensor unit is placed permanently inside the conditioned space in a central location, excluding attachment to exterior walls, and another remote sensor unit is placed permanently outside of the conditioned space.	**2**	0	☐	
905.2		**905.2 Kitchen exhaust.** A kitchen exhaust unit(s) that equals or exceeds 400 cfm (189 L/s) is installed, and makeup air is provided.	**2**	0	☐	
905.3		**905.3 Enhanced air filtration.** Meet all of the following.	**2**	0		
	(1)	Design for and install a secondary filter rack space for activated carbon filters.			☐	
	(2)	Provide the manufacturer's recommended filter maintenance schedule to the homeowner or building manager.			☐	
905.4		**905.4 Sound barrier.** Provide room-to-room privacy between bedrooms and adjacent living spaces within dwelling units or homes by achieving an articulation index (AI) between 0 and 0.15 per the criteria below. *Articulation Index 0 to 0.05 = STC greater than 55 (NIC greater than 47)* *Articulation Index 0.05 to 0.15 = STC 52 to 55 (NIC 44 to 47)*	**1 SF / 4 MF**	0	☐	
905.5		**905.5 Evaporative coil mold prevention.** For buildings with a mechanical system for cooling, ultraviolet lamps are installed on the cooling coils and drain pans of the mechanical system supplies. Lamps produce ultraviolet radiation at a wavelength of 254 nm so as not to generate ozone. Lamps have ballasts housed in a NEMA-rated enclosure.	**2**	0	☐	

END OF CHAPTER 9

CLICK TO PROCEED TO CHAPTER 10 >>

Current Chapter level: Emerald	**Total Points: 18**
Points away from: Bronze: 0, Silver: 0, Gold: 0, Emerald: 0	
Add'l pts earned above: Bronze: 10, Silver: 8, Gold: 7, Emerald: 6	
Total Chapter Points needed for: Bronze: 8, Silver: 10, Gold: 11, Emerald: 12	
Revision Date: 2/28/2024	

NGBS GREEN
Home Innovation Research Labs

Coding

Practice #	Chapter 10: Operation, Maintenance, and Building Owner Education	Points Available	Points Claimed	Status	Notes
1001 HOMEOWNER'S MANUAL AND TRAINING GUIDELINES FOR ONE- AND TWO-FAMILY DWELLINGS					
1001.0	**1001.0 Intent.** Information on the building's use, maintenance, and green components is provided.				
1001.1	**1001.1** A homeowner's manual is provided and stored in a permanent location in the dwelling that includes the following, as available and applicable. **(Points awarded per two items. Points awarded for non-mandatory items.)**	**1** **8 Max**	0		
(1)	A National Green Building Standard certificate with weblink and completion document.	**N/A**		☐	
(2)	List of green building features (can include the national green building checklist).	**N/A**		☐	
(3)	Product manufacturer's manuals or product data sheet for installed major equipment, fixtures, and appliances. If product data sheet is in the building owners' manual, manufacturer's manual may be attached to the appliance in lieu of inclusion in the building owners' manual.	**N/A**		☐	
(4)	Maintenance checklist.			☐	
(5)	Information on local recycling and composting programs.			☐	
(6)	Information on available local utility programs that purchase a portion of energy from renewable energy providers.			☐	
(7)	Explanation of the benefits of using energy-efficient lighting systems [e.g., compact fluorescent light bulbs, light emitting diode (LED)] in high-usage areas.			☐	
(8)	A list of practices to conserve water and energy.			☐	
(9)	Information on the importance and operation of the home's fresh air ventilation system.	**N/A**		☐	
(10)	Local public transportation options.			☐	
(11)	A diagram showing the location of safety valves and controls for major building systems.			☐	
(12)	Where frost-protected shallow foundations are used, owner is informed of precautions including:			☐	
(a)	instructions to not remove or damage insulation when modifying landscaping.				
(b)	providing heat to the building as required by the ICC IRC or IBC.				
(c)	keeping base materials beneath and around the building free from moisture caused by broken water pipes or other water sources.				
(13)	A list of local service providers that offer regularly scheduled service and maintenance contracts to ensure proper performance of equipment and the structure (e.g., HVAC, water-heating equipment, sealants, caulks, gutter and downspout system, shower and/or tub surrounds, irrigation system).			☐	
(14)	A photo record of framing with utilities installed. Photos are taken prior to installing insulation, clearly labeled, and included as part of the building owners' manual.			☐	
(15)	List of common hazardous materials often used around the building and instructions for proper handling and disposal of these materials.			☐	
(16)	Information on organic pest control, fertilizers, deicers, and cleaning products.			☐	
(17)	Information on native landscape materials and/or those that have low water requirements.			☐	
(18)	Information on methods of maintaining the building's relative humidity in the range of 30 percent to 60 percent.			☐	
(19)	Instructions for inspecting the building for termite infestation.			☐	
(20)	Instructions for maintaining gutters and downspouts and importance of diverting water a minimum of 5 feet away from foundation.			☐	
(21)	A narrative detailing the importance of maintenance and operation in retaining the attributes of a green-built building.			☐	
(22)	Where stormwater management measures are installed on the lot, information on the location, purpose, and upkeep of these measures.			☐	
(23)	Explanation of and benefits from green cleaning in the home.			☐	
(24)	Retrofit energy calculator that provides baseline for future energy retrofits.			☐	
1001.2	**1001. 2 Training of initial homeowners.** Initial homeowners are familiarized with the role of occupants in achieving green goals. Training is provided to the responsible party(ies) regarding equipment operation and maintenance, control systems, and occupant actions that will improve the environmental performance of the building. These include:	**N/A** 8	0	☐	
(1)	HVAC filters.				
(2)	Thermostat operation and programming.				
(3)	Lighting controls.				
(4)	Appliances operation.				
(5)	Water heater settings and hot water use.				
(6)	Fan controls.				
(7)	Recycling and composting practices.				
(8)	Whole-dwelling mechanical ventilation systems.				
1002 CONSTRUCTION, OPERATION, AND MAINTENANCE MANUALS AND TRAINING FOR MULTI-UNIT BUILDINGS					
1002.0	**1002.0 Intent.** Manuals are provided to the responsible parties (owner, management, tenant, and/or maintenance team) regarding the construction, operation, and maintenance of the building. Paper or digital format manuals are to include information regarding those aspects of the building's construction, maintenance, and operation that are within the area of responsibilities of the respective recipient. One or more responsible parties are to receive a copy of all documentation for archival purposes.				
1002.1	**1002.1 Building construction manual.** A building construction manual, including five or more of the following, is compiled and distributed in accordance with Section 1002.0. **(Points awarded per two items. Points awarded for non-mandatory items.)**	**1**	**2**		
(1)	A narrative detailing the importance of constructing a green building, including a list of green building attributes included in the building. This narrative is included in all responsible parties' manuals.	**Mandatory**		☑	
(2)	A local green building program certificate as well as a copy of the *National Green Building Standard™*, as adopted by the Adopting Entity, and the individual measures achieved by the building.	**Mandatory**		☑	
(3)	Warranty, operation, and maintenance instructions for all equipment, fixtures, appliances, and finishes.	**Mandatory**		☑	
(4)	Record drawings of the building.			☑	
(5)	A record drawing of the site including stormwater management plans, utility lines, landscaping with common name and genus/species of plantings.			☑	
(6)	A diagram showing the location of safety valves and controls for major building systems.			☑	
(7)	A list of the type and wattage of light bulbs installed in light fixtures.			☑	
(8)	A photo record of framing with utilities installed. Photos are taken prior to installing insulation and clearly labeled.			☐	

1002.2		**1002.2 Operations manual.** Operations manuals are created and distributed to the responsible parties in accordance with Section 1002.0. Between all of the operation manuals, five or more of the following options are included.	1	2		
		(Points awarded per two items. Points awarded for non-mandatory items.)				
	(1)	A narrative detailing the importance of operating and living in a green building. This narrative is included in all responsible parties' manuals.	Mandatory		☑	
	(2)	A list of practices to conserve water and energy (e.g., turning off lights when not in use, switching the rotation of ceiling fans in changing seasons, purchasing ENERGY STAR appliances and electronics).	Mandatory		☑	
	(3)	Information on methods of maintaining the building's relative humidity in the range of 30 percent to 60 percent.			☑	
	(4)	Information on opportunities to purchase renewable energy from local utilities or national green power providers and information on utility and tax incentives for the installation of on-site renewable energy systems.			☐	
	(5)	Information on local and on-site recycling and hazardous waste disposal programs and, if applicable, building recycling and hazardous waste handling and disposal procedures.			☑	
	(6)	Local public transportation options.			☐	
	(7)	Explanation of the benefits of using compact fluorescent light bulbs, LEDs, or other high-efficiency lighting.			☐	
	(8)	Information on native landscape materials and/or those that have low water requirements.			☐	
	(9)	Information on the radon mitigation system, where applicable.			☑	
	(10)	A procedure for educating tenants in rental properties on the proper use, benefits, and maintenance of green building systems including a maintenance staff notification process for improperly functioning equipment.			☑	
	(11)	Information on the importance and operation of the building's fresh air ventilation system.	N/A		☑	
1002.3		**1002.3 Maintenance manual.** Maintenance manuals are created and distributed to the responsible parties in accordance with Section 1002.0. Between all of the maintenance manuals, five or more of the following options are included.	1	2		
		(Points awarded per two items. Points awarded for non-mandatory items.)				
	(1)	A narrative detailing the importance of maintaining a green building. This narrative is included in all responsible parties' manuals.	Mandatory		☑	
	(2)	A list of local service providers that offer regularly scheduled service and maintenance contracts to ensure proper performance of equipment and the structure (e.g., HVAC, water-heating equipment, sealants, caulks, gutter and downspout system, shower and/or tub surrounds, irrigation system).			☑	
	(3)	User-friendly maintenance checklist that includes: **(a)** HVAC filters **(b)** thermostat operation and programming **(c)** lighting controls **(d)** appliances and settings **(e)** water heater settings **(f)** fan controls			☑	
	(4)	List of common hazardous materials often used around the building and instructions for proper handling and disposal of these materials.			☑	
	(5)	Information on organic pest control, fertilizers, deicers, and cleaning products.			☐	
	(6)	Instructions for maintaining gutters and downspouts and the importance of diverting water a minimum of 5 feet away from foundation.			☑	
	(7)	Instructions for inspecting the building for termite infestation.			☑	
	(8)	A procedure for rental tenant occupancy turnover that preserves the green features.			☐	
	(9)	An outline of a formal green building training program for maintenance staff.			☐	
	(10)	A green cleaning plan which includes guidance on sustainable cleaning products.			☐	
	(11)	A maintenance plan for active recreation and play spaces (e.g., playgrounds, ground markings, exercise equipment.			☐	
1002.4		**1002.4 Training of building owners.** Building owners are familiarized with the role of occupants in achieving green goals. On-site training is provided to the responsible party(ies) regarding equipment operation and maintenance, control systems, and occupant actions that will improve the environmental performance of the building. These include: (1) HVAC filters (2) thermostat operation and programming (3) lighting controls (4) appliances operation (5) water heater settings and hot water use (6) fan controls (7) recycling and composting practices (8) Whole-dwelling mechanical ventilation systems	Mandatory 8	8	☑	
1002.5		**1002.5 Multifamily occupant manual.** An occupant manual is compiled and distributed in accordance with Section 1002.0. *[Points awarded for non-mandatory items.]*	1 per 2 items	0		
	(1)	NGBS certificate	Mandatory		☑	
	(2)	List of green building features	Mandatory		☑	
	(3)	Operations manuals for all appliances and occupant operated equipment including lighting and ventilation controls, thermostats, etc.	Mandatory		☑	
	(4)	Information on recycling and composting programs			☐	
	(5)	Information on purchasing renewable energy from utility			☐	
	(6)	Information on energy efficient replacement lamps			☐	
	(7)	List of practices to save water and energy			☐	
	(8)	Local public transportation options			☑	
	(9)	Explanation of benefits of green cleaning			☐	
1002.6		**1002.6 Training of multifamily occupants.** Prepare a training outline, video or website that familiarizes occupants with their role in maintaining the green goals of the project. Include all equipment that the occupant(s) is expected to operate including but not limited.	1 per 2 items	1		
	(1)	Lighting controls			☐	
	(2)	Ventilation controls			☑	
	(3)	Thermostat operation and programming			☑	
	(4)	Appliances operation			☑	
	(5)	Recycling and composting			☐	
	(6)	HVAC filters			☐	
	(7)	Water heater setting and hot water use			☐	
1003 PUBLIC EDUCATION						
1003.0		**1003.0 Intent.** Increase public awareness of the National Green Building Standard and projects constructed in accordance with National Green Building Standard to help increase demand for high-performance homes.				
1003.1		**1003.1 Public Education.** One or more of the following is implemented:	2 Max	1		
	(1)	**Signage.** Signs showing the project is designed and built in accordance with the National Green Building Standard are posted on the construction site.	1		☐	
	(2)	**Certification Plaques.** National Green Building Standard certification plaques with rating level attained are placed in a conspicuous location near the utility area of the home or, in a conspicuous location near the main entrance of a multifamily building.	1		☑	
	(3)	**Education.** A URL for the National Green Building Standard is included on site signage, builder website (or property website for multifamily buildings), and marketing materials for homes certified under the National Green Building Standard.	1		☐	

1004 POST OCCUPANCY PERFORMANCE ASSESSMENT

1004.0		**1004.0 Intent.** A verification system for post occupancy assessment of the building is intended to be a management tool for the building owner to determine if energy or water usage have deviated from expected levels so that inspection and correction action can be taken.				
1004.1		**1004.1** A verification system plan is provided in the building owner's manual (Sections 1001 or 1002). The verification system provides methods for demonstrating continued energy and water savings that are determined from the building's initial year of occupancy of water and energy consumption as compared to annualized consumption at least every four years.				
	(1)	Verification plan is developed to monitor post-occupancy energy and water use and is provided in the building owner's manual.	**1**	0	☐	
	(2)	Verification system is installed in the building to monitor post-occupancy energy and water use.	**3**	0	☐	

1005 INNOVATIVE PRACTICES

1005.1		**1005.1 Appraisals.** One or more of the following is implemented:				
	(1)	Energy rating or projected usage data is posted in an appropriate location in the home, or public posting so that an appraiser can access the energy data for an energy efficiency property valuation.	**2**	0	☐	
	(2)	An Appraisal Institute Form 820.05 "Residential Green and Energy Addendum" or Form 821 "Commercial Green and energy Efficient Addendum" that consider NGBS, LEED, ENERGY STAR certifications and equivalent programs, is completed for the appraiser by a qualified professional or builder to use in performing the valuation of the property.	**2**	0	☐	
	(3)	NGBS certification information or one of the Appraisal Institute Forms cited in (2) above is uploaded to a multiple listing service (MLS) or equivalent database so that appraisers can access it to compare property valuations.	**2**	2	Home Innovation makes key certification details available, but MLS organizations need to take affirmative action to ensure data is received and made publicly available. Contact us for more details.	

END OF CHAPTER 10

Selected	Coding	Coding+Points				
						Required Documentation
P	P		**500 LOT DESIGN, PREPARATION AND DEVELOPMENT**			
			500.0		**500.0 Intent**. This section applies to lot development for the eventual construction of residential buildings, multifamily buildings, or additions thereto that contain dwelling units or sleeping units.	
P	P		**501 LOT SELECTION**			
			501.1		**501.1 Lot.** Lot is selected in accordance with § 501.1(1) or § 501.1(2).	Certificate of Certification for land development. Verify with Home Innovation that site attained NGBS Green certification or verify development is certified by an equivalent program.
P	P			**(1)**	A lot is selected within a site certified to this Standard or equivalent	
P	P			**(2)**	A lot is selected to minimize environmental impact by one or more of the following:	
P	P			**(a)**	An infill lot is selected.	For (a) evidence that land adjacent to lot was previously developed for at least 5 years previously; for (b) evidence that lot itself was previously developed; and for (c) evidence that lot is a brownfield. Brownfields must be recognized by EPA to earn points. Use your best judgement – if scoring a SF development, you can award the points for all lots if the community is largely surrounded by previously developed land. Alternatively, if the site and lots feel more like a greenfield and in an area that is on the fringes of development, do not award these points.
				(b)	A lot is selected that is a greyfield.	
				(c)	An EPA-recognized brownfield lot is selected.	
P	P		**501.2**		**501.2 Multi-modal transportation.** A range of multi-modal transportation choices are promoted by one or more of the following:	
P	P			**(1)**	A lot is selected within one-half mile (805 m) of pedestrian access to a mass transit system	Map showing location of transportation relative to the building on the lot.
				(2)	A lot is selected within five miles (8,046 m) of a mass transit station with provisions for parking.	Map showing distance is based driving from the lot and not from the community entrance.
				(3)	Walkways, street crossings, and entrances designed to promote pedestrian activity are provided. New buildings are connected to existing sidewalks and areas of development.	Review of site plan. Infrastructure in the community should be considered applicable to this practice.
P	P			**(4)**	A lot is selected within one-half mile (805 m) of six or more community resources No more than two each of the following use category can be counted toward the total: Recreation, Retail, Civic, and Services. Examples of resources in each category include, but are not limited to the following:	Map or approved site plan showing location of committed community resources relative to lot.
P	P				Recreation: recreational facilities (such as pools, tennis courts, basketball courts), parks.	
P	P				Retail: grocery store, restaurant, retail store.	
P	P				Civic: post office, place of worship, community center.	
					Services: bank, daycare center, school, medical/dental office, laundromat/dry cleaners.	
					NOTE: List the 6 community resources in the Notes field.	
					OR A lot is selected within a census block group that, compared to its region, has above-average neighborhood walkability using an index within the EPA's Smart Location Database:	Documentation: Go to EPA Points for Smart Location Practices. Click OPEN IN MAP VIEWER box in upper right. Enter home address for property seeking certification search box in upper right. Make sure LEGEND button clicked on left side. Use Legend to determine points based on color of the address on map.
				(a)	Walkability is within the top quartile for the region.	
				(b)	Walkability is within the second quartile for the region.	
				(5)	Bicycle use is promoted by building on a lot located within a community that has rights-of-way specifically dedicated to bicycle use in the form of paved paths or bicycle lanes, or on an infill lot located within 1/2 mile of a bicycle lane designated by the jurisdiction.	Community site plan or official local jurisdiction bike lane map.
				(6)	Dedicated bicycle parking and racks are indicated on the site plan and constructed for mixed-use and multifamily buildings:	Site plan showing location of designated bicycle parking and racks.
				(a)	Minimum of 1 bicycle parking space per 3 residential units	
				(b)	Minimum of 1 bicycle parking space per 2 residential units	
				(c)	Minimum of 1 bicycle parking space per 1 residential unit.	
				(d)	Bicycle enclosed storage is provided or parking spaces are covered or otherwise protected from the elements	
				(7)	Select a lot in a community where there is access to shared vehicle usage such as carpool drop-off areas, car-share services, and shuttle services to mass transit.	Site plan showing location of car-share services and/or shuttle and possibly contracts or commitment from car sharing companies.
					NOTE: Enter name of car sharing program.	
				(8)	Lot is within 1/2 mile walking distance of where a bike sharing program is provided.	Map that shows bike sharing docks are within ½ mile from site OR confirmation that dockless bikes are available to residents. If the latter, please confirm that the dockless bikes are not merely a pilot that might not be continued in the future. Access to scooters are an acceptable alternative to bike sharing.
					NOTE: Enter name of bike sharing program.	
P	P		**502 PROJECT TEAM, MISSION STATEMENT, AND GOALS**			
P	P		**502.1**		**502.1 Project team, mission statement, and goals.** A knowledgeable team is established and team member roles are identified with respect to green lot design, preparation, and development. The project's green goals and objectives are written into a mission statement.	Written project mission statement, goals, and specific team member roles identified. Points can be awarded if the developer of the community establishes a team for this purpose with identified roles and written goals, objectives, and a mission statement, and the covenants for homes built in the community support the mission.
P	P		**503 LOT DESIGN**			
			503.0		**503.0 Intent.** The lot is designed to avoid detrimental environmental impacts first, to minimize any unavoidable impacts, and to mitigate for those impacts that do occur. The project is designed to minimize environmental impacts and to protect, restore, and enhance the natural features and environmental quality of the lot. **(Points awarded only if the intent of the design is implemented.)**	
			503.1		**503.1 Natural resources.** Natural resources are conserved by one or more of the following:	Both a plan and implementation is required to award points. Lot specific information for:
				(1)	A natural resources inventory is completed under the direction of a qualified professional.	Natural resource inventory that includes lot specific information and is signed by qualified professional.
				(2)	A plan is implemented to conserve the elements identified by the natural resource inventory as high-priority resources.	Written conservation plan that includes the lot. There must be high priority resources on the lot or in the development. Examples of high priority resources include trees, waterways, snags, micro-
				(3)	Items listed for protection in the natural resource inventory plan are protected under the direction of a qualified professional.	Statement from professional that s/he directed plan implementation to protect the high priority resources.
				(4)	Basic training in tree or other natural resource protection is provided for the on-site supervisor.	Evidence of site supervisor training. Review builder's standard written training program and/or training certificate.
				(5)	All tree pruning on-site is conducted by a certified arborist or other qualified professional.	Invoice or other evidence from Certified Arborist.
				(6)	Ongoing maintenance of vegetation on the lot during construction is in accordance with TCIA A300 or locally accepted best practices.	Statement from professional that maintenance of vegetation during construction complies.
				(7)	Where a lot adjoins a landscaped common area, a protection plan from construction activities next to the common area is implemented.	Written conservation plan.

NGBS Green is a site-verified certification. All homes or buildings seeking certification must undergo visually inspection and testing by an accredited NGBS Green Verifier. Each building typically has two inspections—a rough inspection before drywall is installed and another once construction has been completed. Some practices will require site inspection, while others require a combination of site inspection and documentation or testing by a qualified professional. Documents, plans, and specifications are required for verification. See below for the documentation that the verifier will need to award points toward certification.

			(8)	Developer has a plan to design and construct the lot in accordance with the International Wildland-Urban Interface Code (IWUIC). *[Only applicable where the AHJ has not declared a wildland-urban interface area, but a fire protection engineer, certified fire marshal, or other qualified party has determined and documented the site as hazarded per the IWUIC].*	Review plan for compliance.
		503.2		**503.2 Slope disturbance.** Slope disturbance is minimized by one or more of the following:	
				Note: Points are only available for lots with slopes of 25% or greater.	
			(1)	The use of terrain adaptive architecture.	None.
			(2)	Hydrological/soil stability study is completed and used to guide the design of all buildings on the lot.	Hydrological study report applicable to the lot and statement that the intent of the requirement is met.
			(3)	All or a percentage of driveways and parking are aligned with natural topography to reduce cut and fill.	Report from qualified professional indicating the percent alignment.
			(a)	10 percent to < 25 percent	
			(b)	25 percent to 75 percent	
			(c)	greater than 75 percent	
			(4)	Long-term erosion effects are reduced through the design and implementation of clustering, terracing, retaining walls, landscaping, or restabilization techniques.	Report from qualified professional stating intent of the requirement has been met through the site plan.
			(5)	Underground parking uses the natural slope for parking entrances.	None.
P	P	**503.3**		**503.3 Soil disturbance and erosion.** Soil disturbance and erosion are minimized by one or more of the following: (also see Section 504.3)	
P	P			Note: Points must be earned in 503.3 in order for points in 504.1 to be available	
P	P		**(1)**	Construction activities are scheduled such that disturbed soil that is to be left unworked for more than 21 days is stabilized within 14 days.	Construction schedule. Verify that schedule limited soil exposure to 14-day EPA guideline or less. Verify visually that the state of the lot is consistent with the schedule. Un-stabilized soil exposure should be limited to 14 days or less if that area will not be further disturbed during a 21-day period. The construction schedule must include specific activities at specific stages to address stabilization.
P	P				
P	P				
P	P		**(2)**	At least 75% of total length of the utilities on the lot are designed to use one or more alternative means:	Plans & scopes of work showing alternative means used.
P	P		**(a)**	tunneling instead of trenching	
			(b)	use of smaller (low ground pressure) equipment or geomats to spread the weight of construction equipment	
			(c)	shared utility trenches or easements	
			(d)	placement of utilities under paved surfaces instead of yards	
P	P		**(3)**	Limits of clearing and grading are demarcated on the lot plan.	Plans showing grading & clearing limits.
P	P	**503.4**		**503.4 Stormwater Management.** The stormwater management system is designed to use low impact development/green infrastructure practices to preserve, restore or mitigate changes in site hydrology due to land disturbance and the construction of impermeable surfaces through the use of one or more of the following techniques:	Hydrologic study report verifying intent of the requirement has been met.
P	P				
P	P				
P	P			NOTE: For lots in a development, the points for 503.4 may be awarded for the lot when there is a community storm water management plan implemented and the builder does not violate that plan with respect to water leaving the lot.	
P	P		**(1)**	A site assessment is conducted and a plan prepared and implemented that identifies important existing permeable soils, natural drainage ways and other water features, e.g., depressional storage, onsite to be preserved in order to maintain site hydrology.	Site assessment and plan that identifies important existing permeable soils, natural drainage ways and other water features. Photos or other document showing water & natural drainage prior to development.
P	P				
P	P				
			(2)	A hydrologic analysis is conducted that results in the design of a stormwater management system that maintains the pre-development (stable, natural) runoff hydrology of the site through the development or redevelopment process. Ensure that post construction runoff rate, volume and duration do not exceed predevelopment rates, volume and duration.	Hydrologic analysis; plans that show features to minimize concentrated flows
			(3)	Low Impact Development/Green infrastructure stormwater management practices to promote infiltration and evapotranspiration are used to manage rainfall on the lot and prevent the off-lot discharge of runoff from all storms up to and including the volume of following storm events:	Engineer's report showing storm event for which points are claimed will not result in rainwater leaving the lot
			(a)	80th percentile storm event	
			(b)	90th percentile storm event	
			(c)	95th percentile storm event	
			(4)	Permeable materials are used for driveways, parking areas, walkways, patios, and recreational surfaces and the like according to the following percentages:	Calculation showing % of hardscape surface covered with permeable materials.
			(a)	10 percent to less than 25 percent (add 2 points for use of vegetative paving system)	
			(b)	25-50 percent (add 4 points for use of vegetative paving system)	
			(c)	Greater than 50 percent (add 6 points for use of vegetative paving system)	
				[Points for vegetative paving systems are only awarded for locations receiving more than 20 inches per year of annual average precipitation]	
P	P		**(5)**	Complete gutter and downspout system directs storm water away from foundation to vegetated landscape area, a raingarden, or catchment system that provides for water infiltration.	None.
P	P				
P	P				
P	P	**503.5**		**503.5 Landscape plan.** A plan for the lot is developed to limit water and energy use while preserving or enhancing the natural environment.	Lot specific plan by qualified landscape professional for any of these sub practices.
P	P				
				(Where "front" only or "rear" only plan is implemented, only half of the points (rounding down to a whole number) are awarded for items (1)-(9))	
			(1)	A plan is formulated and implemented that protects, restores, or enhances natural vegetation on the lot.	Landscape plan that identifies natural vegetation on the lot to be protected, enhanced, or restored.
			(a)	100 percent of the natural area	
			(b)	50 percent of the natural area	
			(c)	25 percent of the natural area	
			(d)	12 percent of the natural area	
			(2)	Non-invasive vegetation that is native or regionally appropriate for local growing conditions is selected to promote biodiversity.	List of regionally appropriate plants must be on plan. Landscape contractor statement or labels on plants.
			(3)	To improve pollinator habitat, at least 10 percent of planted areas are composed of native or regionally appropriate flowering and nectar producing plant species. Invasive plant species shall not be utilized.	Landscape plan by qualified landscape professional that identifies flowering and nectar producing species on at least 10% of planted areas.
			(4)	EPA WaterSense Water Budget Tool or equivalent is used when implementing the site vegetative design.	The tool, available both online and as a Microsoft Excel spreadsheet format on the WaterSense website (https://www.epa.gov/watersense/water-budget-tool), guides the user through the water
			(5)	Where turf is being planted, Turfgrass Water Conservation Alliance (TWCA) or equivalent as determined by the adopting entity third party qualified water efficient grasses are used.	Confirm that turf planted is compliant. List of TWCA grasses is available here (https://www.tgwca.org/list-of-qualified-products.html).
			(6)	For landscaped vegetated areas, the maximum percentage of turf area is:	Calculation showing % of lot (minus building footprint & hardscape) that is turf.
			(a)	0 percent	
			(b)	Greater than 0 percent to less than 20 percent	
			(c)	20 percent to less than 40 percent	
			(d)	40 percent to 60 percent	

P	P		(7)	Plants with similar watering needs are grouped (hydrozoning) and shown on the lot plan.	Landscape plan by qualified landscape professional showing plants and their respective watering needs.
			(8)	Summer shading by planting installed to shade a minimum of 30 percent of building walls. To conform to summer shading, the effective shade coverage (five years after planting) is the arithmetic mean of the shade coverage calculated at 10 am for eastward facing walls, noon for southward facing walls, and 3 pm for westward facing walls on the summer solstice.	Landscape plan by qualified professional stating intent of practice will be met.
			(9)	Vegetative wind breaks or channels are designed to protect the lot and immediate surrounding lots as appropriate for local conditions.	Landscape plan by qualified landscape professional. The wind breaks are intended to protect the lot.
			(10)	Site or community generated tree trimmings or stump grinding of regionally appropriate trees are used on the lot to provide protective mulch during construction or for landscaping.	PO or invoice for contractor providing onsite recycling.
			(11)	An integrated pest management plan is developed to minimize chemical use in pesticides and fertilizers.	Pest management plan.
			(12)	Developer has a plan for removal or containment of invasive plants from the disturbed areas of the site.	Landscape plan by qualified landscape professional.
			(13)	Developer implements a plan for removal or containment of invasive plants on the undisturbed areas of the site.	Landscape plan by qualified landscape professional.
		503.6		**503.6 Wildlife habitat.** Measures are planned to support wildlife habitat and include at least two of the following:	Development-wide or lot-specific wildlife management plan by a qualified professional.
			(1)	Plants and gardens that encourage wildlife, such as bird and butterfly gardens.	
			(2)	Inclusion of a certified "backyard wildlife" program.	
			(3)	The lot is adjacent to a wildlife corridor, fish and game park, or preserved areas and is designed with regard for this relationship.	
			(4)	Outdoor lighting techniques are utilized with regard for wildlife.	
		503.7		**503.7 Environmentally sensitive areas.** The lot is in accordance with one or both of the following:	
			(1)	The lot does not contain any environmentally sensitive areas that are disturbed by the construction.	Lot specific plan showing no sensitive areas.
			(2)	On lots with environmentally sensitive areas, mitigation and/or restoration is conducted to preserve ecosystem functions lost through development and construction activities.	Lot specific plan showing original location of sensitive areas. Plan by qualified professional showing appropriate mitigation or restoration steps.
		503.8		**503.8 Demolition of existing building.** A demolition waste management plan is developed, posted at the jobsite, and implemented to recycle and/or salvage with a goal of recycling or salvaging a minimum of 50 percent of the nonhazardous demolition waste. (One additional point awarded for every 10 percent of nonhazardous demolition waste recycled and/or salvaged beyond 50 percent).	Demolition waste management plan.
P	P	**504 LOT CONSTRUCTION**			
		504.0		**504.0 Intent.** Environmental impact during construction is avoided to the extent possible; impacts that do occur are minimized and any significant impacts are mitigated.	
P	P	504.1		**504.1 On-site supervision and coordination.** On-site supervision and coordination is provided during on-the-lot clearing, grading, trenching, paving, and installation of utilities to ensure that specified green development practices are implemented. (also see Section 503.3)	Review list of practices implemented from 503.3.
				NOTE: Points must be taken in 503.3 to claim points in 504.1.	
		504.2		**504.2 Trees and vegetation.** Designated trees and vegetation are preserved by one or more of the following:	
			(1)	Fencing or equivalent is installed to protect trees and other vegetation.	Review landscape plan to determine which trees and vegetation are designation for preservation.
			(2)	Trenching, significant changes in grade, and compaction of soil and critical root zones in all "tree save" areas as shown on the lot plan are avoided.	Landscape plan.
			(3)	Damage to designated existing trees and vegetation is mitigated during construction through pruning, root pruning, fertilizing, and watering.	Invoice or other evidence from qualified arborist.
P	P	504.3		**504.3 Soil disturbance and erosion implementation.** On-site soil disturbance and erosion are minimized by one or more of the following in accordance with the SWPPP or applicable plan: (also see Section 503.3)	
P	P		(1)	Sediment and erosion controls are installed on the lot and maintained in accordance with the stormwater pollution prevention plan, where required.	Storm water pollution prevention plan.
P	P		(2)	Limits of clearing and grading are staked out on the lot.	None.
			(3)	"No disturbance" zones are created using fencing or flagging to protect vegetation and sensitive areas on the lot from construction activity.	Plans showing fencing or schedules showing flagging.
			(4)	Topsoil from either the lot or the site development is stockpiled and stabilized for later use and used to establish landscape plantings on the lot.	Confirm with landscape plan.
			(5)	Soil compaction from construction equipment is reduced by distributing the weight of the equipment over a larger area (laying lightweight geogrids, mulch, chipped wood, plywood, OSB, metal plates, or other materials capable of weight distribution in the pathway of the equipment).	Scopes of work or contract documents that require soil compaction reducing measures on the site.
P	P		(6)	Disturbed areas on the lot that are complete or to be left unworked for 21 days or more are stabilized within 14 days using methods as recommended by the EPA or in the approved SWPPP, where required.	As-built construction schedule. Review scheduling documentation that demonstrates steps taken to minimize soil exposure. Verify by field management interview that appropriate schedule is prepared.
			(7)	Soil is improved with organic amendments or mulch.	Scopes of work or contract documents that requires improving soil with organic amendments and mulch. The amount of amendments should be consistent with good landscape practice. A soil analysis or landscape professional would typically be required to identify the most appropriate amendments. Amendments or mulch should be applied to at least 50% of the landscaped area.
P	P		(8)	Utilities on the lot are installed using one or more alternative means: tunneling instead of trenching, use of smaller equipment, use of low ground pressure equipment, use of geomats, shared utility trenches or easements, other. NOTE: List "other" means of installing utilities in the assigned Notes area.	Plans and scope of work showing alternative means used.
			(9)	Inspection reports of stormwater best management practices are available.	Inspection reports of stormwater best management practices.
P	P	**505 INNOVATIVE PRACTICES**			
		505.0		**505.0 Intent.** Innovative lot design, preparation, and development practices are used to enhance environmental performance. Waivers or variances from local development regulations are obtained and innovative zoning is used to implement such practices.	
P	P	505.1		**505.1 Driveways and parking areas.** Driveways and parking areas are minimized or mitigated by one or more of the following:	
P	P		(1)	Off-street parking areas are shared or driveways are shared. Waivers or variances from local	None.

P	P			development regulations are obtained to implement such practices, if required.	
			(2)	In a multifamily project, parking capacity does not exceed the local minimum requirements.	Document with local regulations.
			(3)	Structured parking is utilized to reduce the footprint of surface parking areas.	None.
			(a)	25 percent to less than 50 percent	
			(b)	50 percent to 75 percent	
			(c)	greater than 75 percent	
		505.2		**505.2 Heat island mitigation.** Heat island effect is mitigated by the following.	
			(1)	Hardscape: Not less than 50 percent of the surface area of the hardscape on the lot meets one or a combination of the following methods.	For (b), calculation showing percent of hardscape on the lot included in heat island minimization. Manufacturer's literature with SRI data.
			(a)	Shading of hardscaping: Shade is provided from existing or new vegetation (within five years) or from trellises. Shade of hardscaping is to be measured on the summer solstice at noon.	
			(b)	Light-colored hardscaping: Horizontal hardscaping materials are installed with a solar reflectance index (SRI) of 29 or greater. The SRI is calculated in accordance with ASTM E1980. A default SRI value of 35 for new concrete without added color pigment is permitted to be used instead of measurements.	
			(c)	Permeable hardscaping: Permeable hardscaping materials are installed.	
			(2)	Roofs: Not less than 75 percent of the exposed surface of the roof is vegetated using technology capable of withstanding the climate conditions of the jurisdiction and the microclimate conditions of the building lot. Invasive plant species are not permitted.	Manufacturer's literature with SRI data.
P	P	**505.3**		**505.3 Density.** The average density on the lot on a net developable area basis is:	Calculation of number of units divided by lot size for the building.
			(1)	7 to less than 14 dwelling units/sleeping units per acre (per 4,047 m2)	
			(2)	14 to less than 21 dwelling units/sleeping units per acre (per 4,047 m2)	
			(3)	21 to less than 35 dwelling units/sleeping units per acre (per 4,047 m2)	
			(4)	35 to less than 70 dwelling units/sleeping units per acre (per 4,047 m2)	
			(5)	70 or greater dwelling units/sleeping units per acre (per 4,047 m2)	
		505.4		**505.4 Mixed-use development.**	None.
			(1)	The lot contains a mixed-use building.	
		505.5		**505.5 Multifamily & mixed-use community garden(s).** A portion of the lot is established as a community garden(s), available to residents of the lot, to provide for local food production to residents or area consumers.	Site and/or landscape plan. For (b) verify operation months for any farmers market and/or farm stand.
			(a)	A portion of the lot of at least 250 sq ft is established as community garden(s) for the residents of the site. [*3 points per 250 sq ft]	
			(b)	Locate the project within a 0.5-mile walking distance of an existing or planned farmers market/ farm stand that is open or will operate at least once a week for at least five months of the year.	
			(c)	Areas and physical provisions are provided for composting.	
			(d)	Signs designating the garden area are posted.	
		505.6		**505.6 Multi-Unit Plug-In Electric Vehicle Charging.** Plug-in electric vehicle charging capability is provided for not fewer than 2 percent of parking stalls. [An additional 2 points can be earned for each percentage point above 2% for a maximum of 10 points] Fractional values shall be rounded up to the nearest whole number. Electrical capacity in main electric panels supports Level 2 charging (208/240V- up to 80 amps or in accordance with SAE J1772). Each stall is provided with conduit and wiring infrastructure from the electric panel to support Level 2 charging (208/240V- up to 80 amps or in accordance with SAE J1772) service to the designated stalls, and stalls are equipped with either Level 2 charging AC grounded outlets (208/240V- up to 80 amps or in accordance with SAE J1772) or Level 2 charging stations (208/240V- up to 80 amps or in accordance with SAE J1772) by a third party charging station. NOTE: SF/BTR homes are also eligible if 2% or more of the total of shared/communal/visitor parking stalls in the development/community have plug-in electric vehicle charging capability.	Plan specs. These points are only available for multifamily.
		505.7		**505.7 Multi-unit residential CNG vehicle fueling.** CNG vehicle residential fueling appliances are provided for at least 1 percent of the parking stalls. The CNG fueling appliances shall be listed in accordance with ANSI/CSA NGV 5.1 and installed in accordance with the appliance manufacturer's installation instructions. NOTE: Single-Family/Build-to-Rent homes are also eligible if 1% of the shared/communal/visitor parking stalls in the development have residential CNG vehicle refueling.	Plan specs. These points are only available for multifamily.
		505.8		**505.8 Street network.** Locate the project in an area of high intersection density.	Review definition of high intersection density. Calculate intersection density: Intersection Density = Total number of intersections including dead ends / Area in square miles. Follow these steps: 1. Open the Enviroatlas Interactive Map website (Give it a minute to load) 2. On the left under Enviro Atlas Data, select Commuting and Walkability tab (first blue one) 3. Check the second box for Estimated intersection density of walkable roads per mile 4. Type the address of your building in the address box at the top of the map 5. You will see the building's location and the map will be color-coded 6. Click your mouse within that same color of the building to display the intersection density. 7. Aware points if intersection density meets the NGBS definition
		505.9		**505.9 Smoking prohibitions.** Signs are provided on multifamily and mixed-use lots prohibiting smoking at the following locations: NOTE: Build-to-rent homes are also eligible for (a), (b) and (c) if smoking is prohibited and signs posted for all homes in the development/community. SF homes for sale are not eligible.	Plan specs showing signage. These points are only available for multifamily.
			(a)	Smoking is prohibited within 25 feet (7.5 m) of all building exterior doors and operable windows or building air intakes within 15 (4.5 m) vertical feet of grade or a walking surface.	
			(b)	Smoking is prohibited on decks, balconies, patios and other occupied exterior spaces.	
			(c)	Smoking is prohibited at all parks, playgrounds, and community activity or recreational spaces.	
		505.10		**505.10 Exercise & Recreation Area.** For multifamily buildings, on-site dedicated recreation space for exercise or play opportunities for adults and/or children open and accessible to residents is provided.	Plan specs. These points are only available for multifamily.
			(a)	A dedicated area of at least 400 square feet is provided inside the building with adult exercise and/or children's play equipment.	
			(b)	A courtyard, garden, terrace, or roof space at least 10% of the lot area that can serve as outdoor space for children's play and /or adult activities is provided.	
			(c)	Active play/recreation areas are illuminated at night to extend opportunities for physical activity	

				into the evening.	
P	P			**601 QUALITY OF CONSTRUCTION MATERIALS AND WASTE**	
		601.0		**601.0 Intent.** Design and construction practices that minimize the environmental impact of the building materials are incorporated, environmentally efficient building systems and materials are incorporated, and waste generated during construction is reduced.	
P	P	**601.1**		**601.1 Conditioned floor area.** Finished floor area of a dwelling unit or sleeping unit is limited. Finished floor area is calculated in accordance with ANSI Z765 for single family and ANSI/BOMA Z65.4 for multifamily buildings. Only the finished floor area for stories above grade plane is included in the calculation. [For every 100 square feet (9.29 m2) over 4,000 square feet (372 m2), one point is to be added to rating level points shown in Table 303, Category 7 for each rating level.]	Plans review.
			(1)	less than or equal to 700 square feet (65 m^2)	
			(2)	less than or equal to 1,000 square feet (93 m^2)	
			(3)	less than or equal to 1,500 square feet (139 m^2)	
			(4)	less than or equal to 2,000 square feet (186 m^2)	
			(5)	less than or equal to 2,500 square feet (232 m^2)	
			(6)	greater than 4,000 square feet (372 m^2)	
				(For every 100 square feet (9.29 m^2) over 4,000 square feet (372 m^2), one point is to be added to rating level points shown in Table 303, Category 7 for each rating level.)	
				Multifamily Building Note: For a multifamily building, a weighted average of the individual unit sizes is used for this practice.	
P	P	**601.2**		**601.2 Material usage.** Structural systems are designed or construction techniques are implemented that reduce and optimize material usage.	
P	P		**(1)**	Minimum structural member or element sizes necessary for strength and stiffness in accordance with advanced framing techniques or structural design standards are selected.	Engineer's statement that the intent of the practice has been met.
P	P		**(2)**	Higher-grade or higher-strength of the same materials than commonly specified for structural elements and components in the building are used and element or component sizes are reduced accordingly.	Specifications showing higher grade materials.
P	P		**(3)**	Performance-based structural design is used to optimize lateral force-resisting systems.	Engineer's statement of design report showing performance-based design meeting the intent of the practice.
		601.3		**601.3 Building dimensions and layouts.** Building dimensions and layouts are designed to reduce material cuts and waste. This practice is used for a minimum of 80 percent of the following areas:	Plans showing dimensions & layouts to minimize material usage and waste.
			(1)	floor area	
			(2)	wall area	
			(3)	roof area	
			(4)	cladding or siding area	
			(5)	penetrations or trim area	
		601.4		**601.4 Framing and structural plans.** Detailed framing or structural plans, material quantity lists and on-site cut lists for framing, structural materials, and sheathing materials are provided.	Detailed framing or structural plans, material quantity lists and on-site cut lists for framing, structural materials, and sheathing materials are provided.
P	P	**601.5**		**601.5 Prefabricated components.** Precut or preassembled components, or panelized or precast assemblies are utilized for a minimum of 90 percent for the following system or building:	
P	P		**(1)**	floor system	None.
			(2)	wall system	None.
P	P		**(3)**	roof system	None.
			(4)	modular construction for the entire building located above grade	PO and documentation from producer.
			(5)	manufactured home construction for the entire building located above grade	PO and documentation from producer. For (5) the manufactured home must be secured on a foundation and cannot be on a moveable chassis. The home must also meet the local building code, NOT the HUD manufactured housing code.
P	P	**601.6**		**601.6 Stacked stories.** Stories above grade are stacked, such as in 1½-story, 2-story, or greater structures. The area of the upper story is a minimum of 50 percent of the area of the story below based on areas with a minimum ceiling height of 7 feet (2,134 mm).	None.
			(1)	first stacked story	
			(2)	for each additional stacked story	
P	P	**601.7**		**601.7 Prefinished materials. Prefinished building** materials or assemblies listed below have no additional site-applied finishing material are installed.	List of materials and manufacture's literature (unless pre-finished is obvious) that do not get site finished. Note if used at 90%, 50%, or 35% level.
				(Points awarded for each type of material or assembly.)	
			(a)	interior trim not requiring paint or stain	
			(b)	exterior trim not requiring paint or stain	
			(c)	window, skylight, and door assemblies not requiring paint or stain on one of the following surfaces:	
				i. exterior surfaces	
				ii. interior surfaces	
			(d)	interior wall coverings or systems, floor systems, and/or ceiling systems not requiring paint or stain or other type of finishing application	
			(e)	exterior wall coverings or systems, floor system, and/or ceiling systems not requiring paint or stain or other type of finishing application	
			(1)	90 percent or more of the installed building materials or assemblies listed above:	
			(2)	50 percent to less than 90 percent of the installed building material or assembly listed above:	
			(3)	35 percent to less than 50 percent of the installed building material or assembly listed above:	
		601.8		**601.8 Foundations.** A foundation system that minimizes soil disturbance, excavation quantities, and material usage, such as frost-protected shallow foundations, isolated pier and pad foundations, deep foundations, post foundations, or helical piles is selected, designed, and constructed. The foundation is used on 50 percent or more of the building footprint.	Plans showing foundation details.
				NOTE: Indicate in the assigned Notes area the type designed and constructed: frost-protected shallow foundations, pier and pad foundations, post foundations, or other similar foundation type.	
P	P			**602 ENHANCED DURABILITY AND REDUCED MAINTENANCE**	
		602.0		**602.0 Intent.** Design and construction practices are implemented that enhance the durability of materials and reduce in-service maintenance.	
P	P	**602.1**		**602.1 Moisture Management – Building Envelope**	
P	P	**602.1.1**		**602.1.1 Capillary breaks**	
P	P	**602.1.1.1**		**602.1.1.1** A capillary break and vapor retarder are installed at concrete slabs in accordance with	Plans/specifications AND scope of work(s) detailing how mandatory requirement has been met.

P	P			ICC IRC Sections R506.2.2 and R506.2.3 or ICC IBC Sections 1907 and 1805.4.1.	Photo(s) showing installation. Report from certified professional when the building code exceptions are used.
P	P				
		602.1.1.2		**602.1.1.2** A capillary break between the footing and the foundation wall is provided to prevent moisture migration into foundation wall.	Plans/specifications AND scope of work(s) detailing how this requirement has been met. Photo(s) showing installation.
		602.1.2		**602.1.2 Foundation waterproofing.** Enhanced foundation waterproofing is installed using one or both of the following:	Plans, specification, or scope of work showing enhanced foundation coating.
			(1)	rubberized coating, or	
			(2)	drainage mat	
		602.1.3		**602.1.3 Foundation drainage**	
		602.1.3.1		**602.1.3.1** Where required by the ICC IRC or IBC for habitable and usable spaces below grade, exterior drain tile is installed.	Plans showing exterior drain tile for foundation, if applicable. Photo(s) showing installation.
		602.1.3.2		**602.1.3.2** Interior and exterior foundation perimeter drains are installed and sloped to discharge to daylight, dry well, or sump pit.	Plans showing exterior and interior rain tile for foundation, if applicable.
		602.1.4		**602.1.4 Crawlspaces**	
		602.1.4.1		**602.1.4.1** Vapor retarder in unconditioned vented crawlspace is in accordance with the following, as applicable. Joints of vapor retarder overlap a minimum of 6 inches (152 mm) and are taped.	None.
			(1)	Floors. Minimum 6 mil vapor retarder installed on the crawlspace floor and extended at least 6 inches up the wall and is attached and sealed to the wall.	
			(2)	Walls. Dampproof walls are provided below finished grade.	
		602.1.4.2		**602.1.4.2** Crawlspace that is built as a conditioned area is sealed to prevent outside air infiltration and provided with conditioned air at a rate not less than 0.02 cfm (.009 L/s) per square foot of horizontal area and one of the following is implemented:	
			(1)	a concrete slab over 6 mil polyethylene sheeting. Or other Class I vapor retarder installed in accordance with Section 408.3 or Section 506 of the International Residential Code	Plans/specifications AND scope of work(s) detailing how this requirement has been met. Photo(s) showing installation.
			(2)	6 mil polyethylene sheeting, or other Class I vapor retarder installed in accordance with Section 408.3 or Section 506 of the International Residential Code	None.
		602.1.5		**602.1.5 Termite barrier.** Continuous physical foundation termite barrier provided:	None.
				See Figure 6(3)	
			(1)	In geographic areas that have moderate to heavy infestation potential in accordance with figure 6(3), a no or low toxicity treatment is also installed.	
			(2)	In geographic areas that have a very heavy infestation potential in accordance with figure 6(3), in addition a low toxicity bait and kill termite treatment plan is selected and implemented.	
		602.1.6		**602.1.6 Termite-resistant materials.** In areas of termite infestation probability as defined by Figure 6(3), termite-resistant materials are used as follows:	None.
				See Figure 6(3)	
			(1)	In areas of slight to moderate termite infestation probability: for the foundation, all structural walls, floors, concealed roof spaces not accessible for inspection, exterior decks, and exterior claddings within the first 2 feet (610 mm) above the top of the foundation.	
			(2)	In areas of moderate to heavy termite infestation probability: for the foundation, all structural walls, floors, concealed roof spaces not accessible for inspection, exterior decks, and exterior claddings within the first 3 feet (914 mm) above the top of the foundation.	
			(3)	In areas of very heavy termite infestation probability: for the foundation, all structural walls, floors, concealed roof spaces not accessible for inspection, exterior decks, and exterior claddings.	
P	P	**602.1.7**		**602.1.7 Moisture control measures**	
P	P	**602.1.7.1**		**602.1.7.1** Moisture control measures are in accordance with the following:	
P	P		**(1)**	Building materials with visible mold are not installed or are cleaned or encapsulated prior to	None.
P	P			concealment and closing.	
P	P		**(2)**	Insulation in cavities is dry in accordance with manufacturer's instructions when enclosed (e.g.,	If wet insulation is used, provide documentation of moisture content before enclosure.
P	P			with drywall).	
				NOTE: If "N/A" is selected, explain why in the assigned Notes area.	
P	P		**(3)**	The moisture content of lumber is sampled to ensure it does not exceed 19 percent prior to the	Moisture sampling data by builder or 3rd party.
P	P			surface and/or cavity enclosure.	
P	P	**602.1.7.2**		**602.1.7.2** Moisture content of subfloor, substrate, or concrete slabs is in accordance with the	Flooring manufacturer's recommendations for moisture content. Moisture sampling data by
P	P			appropriate industry standard for the finish flooring to be applied.	builder or 3rd party.
		602.1.7.3		**602.1.7.3** Building envelope assemblies are designed for moisture control based on documented hygrothermal simulation or field study analysis. Hygrothermal analysis is required to incorporate representative climatic conditions, interior conditions and include heating and cooling seasonal variation.	Hygrothermal analysis, such as WUFI.
P	P	**602.1.8**		**602.1.8 Water-resistive barrier.** Where required by the ICC, IRC, or IBC, a water-resistive barrier	Plans, specification, or scope of work showing WRB or drainage plane.
P	P			and/or drainage plane system is installed behind exterior veneer and/or siding.	
				NOTE: If "N/A" is selected, explain why in the assigned Notes area.	
P	P	**602.1.9**		**602.1.9 Flashing.** Flashing is provided as follows to minimize water entry into wall and roof	Plans/construction documents showing flashing details at all required locations.
P	P			assemblies and to direct water to exterior surfaces or exterior water-resistive barriers for	
P	P			drainage. Flashing details are provided in the construction documents and are in accordance	
P	P			with the fenestration manufacturer's instructions, the flashing manufacturer's instructions, or as	
P	P			detailed by a registered design professional.	
P	P		**(1)**	Flashing is installed at all of the following locations, as applicable:	
P	P		**(a)**	around exterior fenestrations, skylights, and doors	
P	P		**(b)**	at roof valleys	
P	P		**(c)**	at all building-to-deck, -balcony, -porch, and -stair intersections	
P	P		**(d)**	at roof-to-wall intersections, at roof-to-chimney intersections, at wall-to-chimney intersections,	
P	P			and at parapets	
P	P		**(e)**	at ends of and under masonry, wood, or metal copings and sills	
P	P		**(f)**	above projecting wood trim	
P	P		**(g)**	at built-in roof gutters, and	
P	P		**(h)**	drip edge is installed at eave and rake edges.	
			(2)	All window and door head and jamb flashing is either self-adhered flashing complying with AAMA 711-13 or liquid applied flashing complying with AAMA 714-15 and installed in accordance with fenestration or flashing manufacturer's installation instructions.	
			(3)	Pan flashing is installed at sills of all exterior windows and doors.	
			(4)	Seamless, preformed kickout flashing, or prefabricated metal with soldered seams is provided at all roof-to-wall intersections. The type and thickness of the material used for roof flashing including but not limited kickout and step flashing is commensurate with the anticipated service life of the roofing material.	

			(5)	A rainscreen wall design as follows is used for exterior wall assemblies	
			(a)	a system designed with minimum 1/4-inch air space exterior to the water-resistive barrier, vented to the exterior at top and bottom of the wall, and integrated with flashing details. OR	
			(b)	a cladding material or a water-resistive barrier with enhanced drainage, meeting 75 percent drainage efficiency determined in accordance with ASTM E2273.	
			(6)	Through-wall flashing is installed at transitions between wall cladding materials or wall construction types.	
			(7)	Flashing is installed at expansion joints in stucco walls.	
		602.1.10		**602.1.10 Exterior doors.** Entries at exterior door assemblies, inclusive of side lights (if any), are covered by one of the following methods to protect the building from the effects of precipitation and solar radiation. Either a storm door or a projection factor of 0.375 minimum is provided. Eastern- and western-facing entries in Climate Zones 1, 2, and 3, as determined in accordance with Figure 6(1) or Appendix A, have either a storm door or a projection factor of 1.0 minimum, unless protected from direct solar radiation by other means (e.g., screen wall, vegetation).	Projection factor calculations = overhang width/ height to the overhang (Measure height from sill of window or door to the overhang). See illustration in the definition section of standard.
				This Project's Climate Zone:	
			(a)	installing a porch roof or awning	
			(b)	extending the roof overhang	
			(c)	recessing the exterior door	
			(d)	Installing a storm door	
				Note: The pedestrian door protected in a garage leading to living space does not qualify for points.	
P	P	602.1.11		**602.1.11 Tile backing materials.** Tile backing materials installed under tiled surfaces in wet areas are in accordance with ASTM C1178, C1278, C1288, or C1325.	Manufacturer's literature/specification/labeling showing ASTM compliance. Plans/specifications and scope of work showing installation.
P	P				
		602.1.12		**602.1.12 Roof overhangs.** Roof overhangs, in accordance with Table 602.1.12, are provided over a minimum of 90 percent of exterior walls to protect the building envelope.	None.
				See Table 602.1.12	
P	P	602.1.13		**602.1.13 Ice barrier.** In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier is installed in accordance with the ICC IRC or IBC at roof eaves of pitched roofs and extends a minimum of 24 inches (610 mm) inside the exterior wall line of the building.	Plans showing ice barrier.
P	P				
P	P				
P	P				
P	P	602.1.14		**602.1.14 Architectural features**. Architectural features that increase the potential for water intrusion are avoided:	None.
P	P				
			(1)	All horizontal ledgers are sloped away to provide gravity drainage as appropriate for the application.	
			(2)	No roof configurations that create horizontal valleys in roof design.	
			(3)	No recessed windows and architectural features that trap water on horizontal surfaces.	
		602.1.15		**602.1.15 Kitchen and vanity cabinets.** All kitchen and vanity cabinets are certified in accordance with the ANSI/KCMA A161.1 performance standard or equivalent.	Manufacturer's literature demonstrating compliance.
				NOTE: Identify what product was used in the assigned Notes area.	
		602.2		**602.2 Roof surfaces.** A minimum of 90 percent of roof surfaces, not used for roof penetrations and associated equipment, on-site renewable energy systems such as photovoltaics or solar thermal energy collectors, or rooftop decks, amenities and walkways, are constructed of one or more of the following:	
			(1)	products that are in accordance with the ENERGY STAR® cool roof certification or equivalent	Manufacturer's literature showing ENERGY STAR Cool Roof or equivalent.
			(2)	a vegetated roof system	None.
			(3)	Minimum initial SRI of 78 for low-sloped roof (a slope less than 2:12) and a minimum initial SRI of 29 for a steep-sloped roof (a slope equal to or greater than 2:12). The SRI is calculated in accordance with ASTM E1980. Roof products are certified and labeled.	Manufacturer's literature showing SRI, alongwith slope calculations.
P	P	602.3		**602.3 Roof water discharge.** A gutter and downspout system or splash blocks and effective grading are provided to carry water a minimum of 5 feet (1524 mm) away from perimeter foundation walls.	None.
P	P				
P	P				
P	P	602.4		**602.4 Finished grade.**	
P	P	602.4.1		**602.4.1** Finished grade at all sides of a building is sloped to provide a minimum of 6 inches (150 mm) of fall within 10 feet (3048 mm) of the edge of the building. Where lot lines, walls, slopes, or other physical barriers prohibit 6 inches (152 mm) of fall within 10 feet (3048 mm), the final grade is sloped away from the edge of the building at a minimum slope of 2 percent.	None.
P	P				
P	P				
P	P				
P	P				
		602.4.2		**602.4.2** The final grade is sloped away from the edge of the building at a minimum slope of 5 percent.	None.
P	P	602.4.3		**602.4.3** Water is directed to drains or swales to ensure drainage away from the structure.	None.
P	P	**603 REUSED OR SALVAGED MATERIALS**			
		603.0		**603.0 Intent.** Practices that reuse or modify existing structures, salvage materials for other uses, or use salvaged materials in the building's construction are implemented.	
		603.1		**603.1 Reuse of existing building.** Major elements or components of existing buildings and structures are reused, modified, or deconstructed for later use.	Plans/documentation showing original square footage. When modified, plans showing modifications. When deconstructed, photos showing process and receipts for donation of major components.
				(Points awarded for every 200 square feet (18.5 m^2) of floor area.)	
				NOTE: Describe materials used in the assigned Notes area. Materials, elements, or components awarded points under Section 603.1 shall not be awarded points under Section 603.2.	
		603.2		**603.2 Salvaged materials.** Reclaimed and/or salvaged materials and components are used. The total material value and labor cost of salvaged materials is equal to or exceeds 1 percent of the total construction cost.	List of the type and quantity of salvaged materials used on this building. Demonstrate that the installed cost of the salvaged materials to be = to or >1% of total construction costs.
				(Points awarded per 1% of salvaged materials used based on the total construction cost.)	
				NOTE: Describe materials used in the assigned Notes area. Materials, elements, or components awarded points under Section 603.1 shall not be awarded points under Section 603.2.	
		603.3		**603.3 Scrap materials.** Sorting and reuse of scrap building material is facilitated (e.g., a central storage area or dedicated bins are provided).	None.
				NOTE: Indicate in the assigned Notes area what salvage materials were sorted for reuse.	
P	P	**604 RECYCLED-CONTENT BUILDING MATERIALS**			
P	P	604.1		**604.1 Recycled content.** Building materials with recycled content are used for two minor and/or two major components of the building.	List of materials used and their respective recycled content percentage. Manufacturer's literature showing recycled content.
P	P				
				Enter material percent recycled content.	
				See Table 604.1	
				NOTE: In the assigned Notes area, list materials used for minor and/or major building components.	

P	P	**605 RECYCLED CONSTRUCTION WASTE**	
		605.0 **605.0 Intent.** Waste generated during construction is recycled.	
P	P	**605.1** **605.1 Hazardous waste.** The construction and waste management plan shall include information on the proper handling and disposal of hazardous waste. Hazardous waste is properly handled and disposed.	Review C&D plan covers hazardous waste.
P	P		
P	P		
		605.2 **605.2 Construction waste management plan.** A construction waste management plan is developed, posted at the jobsite, and implemented diverting, through reuse, salvage, recycling, or manufacturer reclamation, a minimum of 50 percent (by weight) of nonhazardous construction and demolition waste from disposal. For this practice, land clearing debris is not considered construction waste. Materials used as alternative daily cover are considered construction waste and do not count toward recycling or salvaging.	Post C&D waste management plan on-site. Evidence that at least 50% of waste materials are being recycled or salvaged.
		For buildings following the new construction path that also have a renovation component, the waste management plan includes the recycling of 95 percent of electronic waste components (such as printed circuit boards from computers, building automation systems, HVAC, fire and security control boards) by an E-Waste recycling facility.	
		Exceptions:	
		(1) Waste materials generated from land clearing, soil and sub-grade excavation and vegetative debris shall not be in the calculations.	
		(2) A recycling facility (traditional or E-Waste) offering material receipt documentation is not available within 50 miles of the jobsite.	
		605.3 **605.3 On-site recycling.** On-site recycling measures following applicable regulations and codes are implemented, such as the following:	No documentation required, but builder rep shall point out on-site recycling efforts and explain 50% goal.
		(a) Materials are ground or otherwise safely applied on-site as soil amendment or fill. A minimum of 50 percent (by weight) of construction and land-clearing waste is diverted from landfill.	
		(b) Alternative compliance methods approved by the Adopting Entity.	
		(c) Compatible untreated biomass material (lumber, posts, beams, etc.) are set aside for combustion if a solid fuel-burning appliance per Section 901.2.1(2) will be available for on-site renewable energy.	
		605.4 **605.4 Recycled construction materials.** Construction materials (e.g., wood, cardboard, metals, drywall, plastic, asphalt roofing shingles, or concrete) are recycled offsite.	Copy of agreement with and pick-up tickets by recycling contractor, list of materials sent to recycler.
		(1) a minimum of two types of materials are recycled	
		(2) for each additional recycled material type	
		(a) wood	
		(b) cardboard	
		(c) metals	
		(d) drywall	
		(e) plastic	
		(f) asphalt roofing shingles	
		(g) concrete	
		(h) other	
		(i) other	
		NOTE: List "other" types of materials recycled in the assigned Notes area.	
P	P	**606 RENEWABLE MATERIALS**	
		606.0 **606.0 Intent.** Building materials derived from renewable resources are used.	
		606.1 **606.1 Biobased products.** The following biobased products are used:	List of materials and amounts, and manufacturers' literature or certificate documenting materials manufactured from renewable resources used on this site.
		(a) certified solid wood in accordance with Section 606.2	
		(b) engineered wood	
		(c) bamboo	
		(d) cotton	
		(e) cork	
		(f) straw	
		(g) natural fiber products made from crops (soy-based, corn-based)	
		(h) other biobased materials with a minimum of 50 percent biobased content (by weight or volume)	
		Note: Please list "other biobased materials" used in the Notes field	
		(1) Two types of biobased materials are used, each for more than 0.5 percent of the project's projected building material cost.	
		(2) Two types of biobased materials are used, each for more than 1 percent of the project's projected building material cost.	
		(3) For each additional biobased material used for more than 0.5 percent of the project's projected building material cost.	
		606.2 **606.2 Wood-based products.** Wood or wood-based products are certified to the requirements of one of the following:	List of certified wood product types used and literature or stamp showing certification.
		(a) American Forest Foundation's *American Tree Farm System®* (ATFS)	
		(b) Canadian Standards Association's *Sustainable Forest Management System Standards* (CSA Z809)	
		(c) *Forest Stewardship Council* (FSC)	
		(d) *Program for Endorsement of Forest Certification Systems* (PEFC)	
		(e) *Sustainable Forestry Initiative ® Program (SFI)*	
		(f) National Wood Flooring Association's Responsible Procurement Program (RPP)	
		(g) other product programs mutually recognized by PEFC	
		(h) A manufacturer's fiber procurement system that has been audited by an approved agency as compliant with the provisions of ASTM D7612 as a responsible or certified source. Government or tribal forestlands whose water protection programs have been evaluated by an approved agency as compliant with the responsible source designation of ASTM D7612 are exempt from auditing in the manufacturers' fiber procurement system.	
		(1) A minimum of two responsible or certified wood-based products are used for minor components of the building.	
		Note: Please list products and components in the Notes fields	
		(2) A minimum of two responsible or certified wood-based products are used in major components of the building.	
		Note: Please list products and components in the Notes fields	
		606.3 **606.3 Manufacturing energy.** Materials manufactured using a minimum of 33 percent of the primary manufacturing process energy derived from (1) renewable sources, (2) combustible waste sources, or (3) renewable energy credits (RECs) are used for major components of the building.	List materials used and manufacturer's literature showing source and amount of energy used in manufacturing.

			(2 points awarded per material.)	
			Note: Please list materials in the Notes field	
P	P	**607 RECYCLING AND WASTE REDUCTION**		
		607.1	**607.1 Recycling and composting.** Recycling and composting by the occupant are facilitated by one or more of the following methods:	None.
		(1)	A readily accessible space(s) for recyclable material containers is provided and identified on the floorplan of the house or dwelling unit or a readily accessible area(s) outside the living space is provided for recyclable material containers and identified on the site plan for the house or building. The area outside the living space shall accommodate recycling bin(s) for recyclable materials accepted in local recycling programs.	
		(2)	A readily accessible space(s) for compostable material containers is provided and identified on the floorplan of the house or dwelling unit or a readily accessible area(s) outside the living space is provided for compostable material containers and identified on the site plan for the house or building. The area outside the living space shall accommodate composting container(s) for locally accepted materials, or, accommodate composting container(s) for on-site composting.	
		607.2	**607.2 Food waste disposers.** A minimum of one food waste disposer is installed at the primary kitchen sink.	None.
P	P	**608 RESOURCE-EFFICIENT MATERIALS**		
		608.1	**608.1 Resource-efficient materials.** Products containing fewer materials are used to achieve the same end-use requirements as conventional products, including but not limited to:	List the products used and justification that are claimed to use fewer resources if not specifically listed in the practice.
		(1)	lighter, thinner brick with bed depth less than 3 inches and/or brick with coring of more that 25 percent	
		(2)	engineered wood or engineered steel products	
		(3)	roof or floor trusses	
			NOTE: In the assigned Notes area, describe the types of products that comply with 608.1.	
P	P	**609 REGIONAL MATERIALS**		
P	P	**609.1**	**609.1 Regional materials.** Regional materials are used for major and/or minor components of the building.	List the materials or components and manufacturing location used in the home that are extracted, processed, and manufactured within 500 miles.
P	P			
		(1)	Major component	
		(2)	Minor component	
			For a component to comply with this practice, a minimum of 75 percent of all products in that component category must be sourced regionally, e.g., stone veneer category – 75 percent or more of the stone veneer on a project must be sourced regionally.	
			NOTE: In the assigned Notes areas, list major and minor materials used that comply with 609.1.	
P	P	**610 LIFE CYCLE ASSESSMENT**		
		610.1	**610.1 Life cycle assessment.** A life cycle assessment (LCA) tool is used to select environmentally preferable products, assemblies, or, entire building designs. Points are awarded in accordance with Section 610.1.1 or 610.1.2. Only one method of analysis or tool may be utilized. The reference service life for the building is 60 years for any life cycle analysis tool. Results of the LCA are reported in the manual required in Section 1001.1 or 1002.1(1) of this Standard in terms of the environmental impacts listed in this practice and it is stated if operating energy was included in the LCA.	LCA report.
			NOTE: Identify the LCA tool utilized and the person who completed the analysis.	
		610.1.1	**610.1.1 Whole-building life cycle assessment.** A whole-building LCA is performed in conformance with ASTM E2921 using ISO14044 compliant life cycle assessment.	Documented whole-building LCA report.
		(1)	Execute LCA at the whole building level through a comparative analysis between the final and reference building designs as set forth under Standard Practice, ASTM E2921. The assessment criteria includes the following environmental impact categories:	
			(a) Primary energy use	
			(b) Global warming potential	
			(c) Acidification potential	
			(d) Eutrophication potential	
			(e) Ozone depletion potential	
			(f) Smog potential	
		(2)	Execute LCA on regulated loads throughout the building operations life cycle stage. Conduct simulated energy performance analyses in accordance with Section 702.2.1 ICC IECC analysis (IECC Section 405) in establishing the comparative performance of final versus reference building designs. Primary energy use savings and global warming potential avoidance from simulation analyses results are determined using energy supplier, utility, or EPA electricity generation and other fuels energy conversion factors and electricity generation and other fuels emission rates for the locality or Sub-Region in which the building is located	
		(3)	Execute full LCA, including use-phase, through calculation of operating energy impacts (c) – (f) using local or regional emissions factors from energy supplier, utility, or EPA.	
		610.1.2	**610.1.2 Life cycle assessment for a product or assembly.** An environmentally preferable product or assembly is selected for an application based upon the use of an LCA tool that incorporates data methods compliant with ISO 14044 or other recognized standards that compare the environmental impact of products or assemblies.	
		610.1.2.1	**610.1.2.1 Product LCA.** A product with improved environmental impact measures compared to another product(s) intended for the same use is selected. The environmental impact measures used in the assessment are selected from the following:	Documented ISO 14044 LCA report comparing at least two products intended for the same application.
			(a) Primary energy use	
			(b) Global warming potential	
			(c) Acidification potential	
			(d) Eutrophication potential	
			(e) Ozone depletion potential	
			(f) Smog potential	
			(Points are awarded for each product/system comparison where the selected product/system improved upon the environmental impact measures by an average of 15 percent.)	
			NOTE: List products/systems compared & impact measures considered in the assigned Notes area.	
		610.1.2.2	**610.1.2.2 Building assembly LCA.** A building assembly with improved environmental impact measures compared to an alternative assembly of the same function is selected. The full life cycle, from resource extraction to demolition and disposal (including but not limited to on-site	Documented ISO 14044 LCA comparing at least two assemblies intended for the same application.

			construction, maintenance and replacement, material and product embodied acquisition, and process and transportation energy), is assessed. The assessment includes all structural elements, insulation, and wall coverings of the assembly. The assessment does not include electrical and mechanical equipment and controls, plumbing products, fire detection and alarm systems, elevators, and conveying systems. The following types of building assemblies are eligible for points under this practice: **(a)** exterior walls **(b)** roof/ceiling **(c)** interior walls or ceilings **(d)** intermediate floors The environmental impact measures used in the assessment are selected from the following: **(a)** Primary energy use **(b)** Global warming potential **(c)** Acidification potential **(d)** Eutrophication potential **(e)** Ozone depletion potential **(f)** Smog potential **(Points are awarded based on the number of types of building assemblies that improve upon environmental impact measures by an average of 15 percent.)** NOTE: List assemblies compared & impact measures considered in the assigned Notes area.	
P	P	**611 PRODUCT DECLARATIONS**		
		611.1	**611.1 Product declarations.** A minimum of 10 different products installed in the building project, at the time of certificate of occupancy, comply with one of the following sub-sections. Declarations, reports, and assessments are submitted and contain documentation of the critical peer review by an independent third party, results from the review, the reviewer's name, company name, contact information, and date of the review.	Verifier must review and collect type III industry-wide environmental product declaration (EPD) for each product and ensure requirements above are met. Must have a minimum of 10 products.
		611.1.1	**611.1.1 Industry-wide declaration.** A Type III industry-wide environmental product declaration (EPD) is submitted for each product. Where the program operator explicitly recognizes the EPD as representative of the product group on a National level, it is considered industry-wide. In the case where an industry-wide EPD represents only a subset of an industry group, as opposed to being industry-wide, the manufacturer is required be explicitly recognized as a participant by the EPD program operator. All EPDs are required to be consistent with ISO Standards 14025 and 21930 with at least a cradle-to-gate scope. **(Each product complying with Section 611.1.1 shall be counted as one product for compliance with Section 611.1.)** NOTE: List products in the assigned Notes area.	Verifier must review and collect type III industry-wide environmental product declaration (EPD) for each product and ensure requirements above are met. Must have a minimum of 10 products.
		611.1.2	**611.1.2 Product Specific Declaration.** A product specific Type III EPD are submitted for each product. The product specific declaration shall be manufacturer specific for an individual product or product family. All Type III EPDs are required to be certified as complying, at a minimum, with the goal and scope for the cradle-to-gate requirements in accordance with ISO Standards 14025 and 21930. **(Each product complying with Section 611.1.2 shall be counted as two products for compliance with Section 611.1.)** NOTE: List products in the assigned Notes area.	Verifier must review and collect type III industry-wide environmental product declaration (EPD) for each product and ensure requirements above are met. Must have a minimum of 10 products.
P	P	**612 INNOVATIVE PRACTICES**		
		612.1	**612.1 Manufacturer's environmental management system concepts.** Product manufacturer's operations and business practices include environmental management system concepts, and the production facility is registered to ISO 14001 or equivalent. The aggregate value of building products from registered ISO 14001 or equivalent production facilities is 1 percent or more of the estimated total building materials cost. **(1 point awarded per percent.)** NOTE: In the assigned Notes area, list products that comply with manufacturers and ISO registrars.	List of materials used to include manufacturer, cost of materials, and % of total materials cost. Copy of ISO14001 certificate for each material claimed. Analysis showing total material cost.
		612.2	**612.2 Sustainable products.** One or more of the following products are used for at least 30% of the floor or wall area of the entire dwelling unit or the sleeping unit, as applicable. Products are certified by a third-party agency accredited to ISO 17065.	List of certified products with product literature or other evidence of certification.
		(1)	50% or more of carpet installed (by square feet) is certified to NSF 140 or equivalent.	
		(2)	50% or more of resilient flooring installed (by square feet) is certified to NSF 332 or equivalent.	
		(3)	50% or more of the insulation installed (by square feet) is certified to UL 2985 or equivalent.	
		(4)	50% or more of interior wall coverings installed (by square feet) is certified to NSF 342 or equivalent.	
		(5)	50% or more of the gypsum board installed (by square feet) is certified to UL 100 or equivalent.	
		(6)	50% or more of the door leafs installed (by number of door leafs) is certified to UL 102 or equivalent.	
		(7)	50% or more of the tile installed (by square feet) is certified to TCNA A138.1 Specifications for Sustainable Ceramic Tiles, Glass Tiles and Tile Installation Materials or equivalent.	
P	P	**612.3**	**612.3 Universal design elements.** Dwelling incorporates one or more of the following universal design elements. Conventional industry construction tolerances are permitted.	None.
P	P	**(1)**	Any no-step entrance into the dwelling which (1) is accessible from a substantially level parking or drop-off area (no more than 2%) via an accessible path which has no individual change in elevation or other obstruction of more than 1-1/2 inches in height with the pitch not exceeding 1 in 12 and (2) provides a minimum 32-inch wide clearance into the dwelling.	
		(2)	Minimum 36-inch wide accessible route from the no-step entrance into at least one visiting room in the dwelling and into at least one full or half bathroom which has a minimum 32-inch clear door width and a 30-inch by 48-inch clear area inside the bathroom outside the door swing.	
		(3)	Minimum 36-inch wide accessible route from the no-step entrance into at least one bedroom which has a minimum 32-inch clear door width.	
		(4)	Blocking or equivalent installed in the accessible bathroom walls for future installation of grab bars at water closet and bathing fixture, if applicable.	
		(5)	All interior and exterior door handles are levers rather than knobs.	
		(6)	All sink, lavatory and showering controls that comply with ICC A117.1.	
		(7)	Interior convenience Power receptacles, communication connections (for cable, phone, Ethernet, etc.) and switches are placed between 15" and 48" above the finished floor. Additional switches	

				to control devices and systems (such as alarms, home theaters and other equipment) not required by the local building code may be installed as desired.	
			(8)	All light switches are rocker-type switches or other similar switches that can be operated by pressing them (with assistive devices). Toggle-type switches may not be used.	
			(9)	Any of the following can be controlled with a (wireless) mobile device such as a smartphone, tablet or laptop computer: HVAC, lighting, alarm system or door locks	
P	P	**613 RESILIENT CONSTRUCTION**			
P	P	**613.1**		**613.1 Intent.** Design and construction practices developed by a licensed design professional or equivalent are implemented that enhance the resilience and durability of the structure (above building code minimum design loads) so the structure can better withstand forces generated by; flooding, snow, wind or seismic activity (as applicable) and reduce the potential for the loss of life and property.	Signed statement and plans by a licensed design professional (such as an architect or an engineer) or equivalent that the design and construction practices implemented in the building enhance the resilience and durability of the structure by designing and building to forces generated by; flooding, snow, wind or seismic (as applicable) to the desired level above the base design.
			(a)	**Minimum structural requirements (base design).** The building is designed and constructed in compliance with structural requirements in the IBC or IRC as applicable.	
			(b)	**Enhanced resilience – 10% above base design.** Design and construction practices are implemented that enhance the resilience and durability of the structure by designing and building to forces generated by; flooding, snow, wind or seismic (as applicable) that are 10% higher than the base design.	
			(c)	**Enhanced resilience – 20% above base design.**	
			(d)	**Enhanced resilience – 30% above base design.**	
			(e)	**Enhanced resilience – 40% above base design.**	
			(f)	**Enhanced resilience – 50% above base design.**	
P	P	**701 MINIMUM ENERGY EFFICIENCY REQUIREMENTS**			
		701.1		**701.1 Mandatory requirements.** The building shall comply with Section 702 (Performance Path), Section 703 (Prescriptive Path), or Section 704 (ERI Target Path). Items listed as "mandatory" in Section 701.4 apply to all Paths. Unless otherwise noted, buildings in the Tropical Climate Zone shall comply with Climate Zone 1 requirements.	
				Please indicate energy modeler's professional credential and, in the notes field, their name. When selecting "Other," enter professional credentials (e.g., engineer, architect) within the notes field.	
		701.1.1		**701.1.1 Minimum Performance Path requirements.** A building complying with § 702 shall include a minimum of two practices from § 705, or a minimum of one practice from § 705 and a minimum of one practice from § 706.	Acceptable software includes, among others, REM/Rate, Open Studio, or Energy Gauge. [See Energy Efficiency Modeling Policy in VRG Part I.] The same software report can be used to support performance point claim in Section 702.
		701.1.2		**701.1.2 Minimum Prescriptive Path requirements.** A building complying with § 703 shall obtain a minimum of 30 points from § 703 and shall include a minimum of two practices from § 705, or a minimum of one practice from § 705 and a minimum of one practice from § 706.	None.
P	P	**701.1.3**		**701.1.3 ERI Target Path requirements.** A building complying with § 704 shall obtain a minimum of 30 points from § 704 and shall include a minimum of two practices from § 705, or a minimum of one practice from § 705 and a minimum of one practice from § 706.	ERI report showing confirmed features and energy performance.
		701.1.4		**701.1.4 Alternative bronze and silver level compliance**. As an alternative, any building that qualifies as an ENERGY STAR Version 3.0 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev. 03 building or demonstrates compliance with the 2018 IECC or Chapter 11 of the 2018 IRC achieves the bronze level for Chapter 7. As an alternative, any building that qualifies as an ENERGY STAR Version 3.1 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev. 03 (with the baseline at ASHRAE 90.1-2010) building achieves the silver level for Chapter 7. As an alternative in the Tropical Climate Zone, any building that meets all of the requirements in IECC Section R401.2.1 (Tropical Zone) achieves the silver level for Chapter 7. The buildings achieving compliance under Section 701.1.4 are not eligible for achieving a rating level above silver.	ENERGY STAR certificate and energy performance report showing confirmed features and energy performance that demonstrates that meeting that the building qualifies for ENERGY STAR and which version. OR Statement from a qualified energy professional that the building meets the IECC's Tropical Climate Zone requirements. OR REScheck or COMcheck report(s) showing IECC or IRC compliance. Reports should reflect unamended 2018 IECC compliance. For COMcheck, verifiers should review and submit all report versions, namely envelope, interior lighting, exterior lighting, and mechanical compliance.
		701.1.6		**701.1.6 Alternative gold level compliance for tropical zones**. One- or two-family dwelling in the tropical zone at an elevation less than 2,400 feet (731.5 m) above sea level that complies with the following shall achieve the gold level for chapter 7:	REScheck or COMcheck report; manufacturer's literature
			(1)	The residence complies with IECC Tropical Zone than section R401.2.1.	
			(2)	The residence includes a minimum of 2 kW of PV and a minimum of 6 kWh of battery storage.	
			(3)	Any air conditioning has a minimum of 18 SEER.	
			(4)	Solar, wind or other renewable energy source supplies not less than 90 percent of the energy for service water heating.	
			(5)	Glazing in conditioned spaces has a solar heat gain coefficient of less than or equal to 0.25, or has an overhang with a projection factor equal to or greater than 0.30.	
			(6)	The exterior roof/ceiling complies with at least two of the following:	
				(a) Minimum roof reflectance and emittance in IECC Table C402.3	
				(b) Roof or ceiling has insulation with an R-value of R-15 or greater	
				(c) Includes a radiant barrier	
			(7)	Walls comply with at least one of the following:	
				(a) Walls have an overhang with a projection factor equal to or greater than 0.30	
				(b) Walls have insulation with an R-value of R-13 or greater	
				(c) Walls have a solar reflectance of 0.64	
			(8)	A ceiling fan is provided for bedrooms and the largest space that is not used as a bedroom; alternately a whole house fan is provided.	
			(9)	Wiring sufficient for a Level 2 (208/240V 40-80 amp) electric vehicle charging station is installed on the building site.	
		701.2		**701.2 Emerald level points.** The Performance Path (Section 702) or the ERI Target Path (Section 704) shall be used to achieve the emerald level.	
		701.3		**701.3 Adopting Entity review.** A review by the Adopting Entity or designated third party shall be conducted to verify design and compliance with Chapter 7.	3rd party report/statement showing design has been reviewed to ensure energy efficient performance or specific prescriptive details are adequately implemented in the building's design, and to ensure proper integration of various energy efficient technologies. In Climate Zone 1, PE must sign off that the system will maintain the cooling season indoor humidity less than the ASHRAE Simplified method for Design Indoor RH (70%) if the system size is not consistent with Manual S.
				NOTE: List the reviewer in the assigned Notes field.	
P	P	**701.4**		**701.4 Mandatory practices.**	
P	P	**701.4.1**		**701.4.1 HVAC systems.**	
P	P	**701.4.1.1**		**701.4.1.1 HVAC system sizing.** Space heating and cooling system is sized according to heating and cooling loads calculated using ACCA Manual J, or equivalent. Equipment is selected using ACCA Manual S or equivalent.	Software output report for this building using ACCA Manual J AND Manual S or equivalent.
P	P	**701.4.1.2**		**701.4.1.2 Radiant and hydronic space heating.** Where installed as a primary heat source in the	REQUIRED if applicable: When primary heat source in the building is a radiant or hydronic heating

P	P			building, radiant or hydronic space heating system is designed, installed, and documented, using industry-approved guidelines and standards (e.g., ACCA Manual J, AHRI I=B=R, ACCA 5 QI-2010, or an accredited design professional's and manufacturer's recommendations).	system, a statement from qualified professional of system design using industry-approved guidelines. The statement must be specific to the building being verified. When there is not a radiant or hydronic system as primary heat indicate that via the appropriate dropdown menu choice.
P	P	**701.4.2**		**701.4.2 Duct systems.**	
P	P	**701.4.2.1**		**701.4.2.1 Duct air sealing.** Ducts are air sealed. All duct sealing materials are in conformance with UL 181A or UL 181B specifications and are installed in accordance with manufacturer's instructions.	For buildings with ducted systems provide product spec or trade contractor's scope of work to confirm use of duct sealing using UL 181 tape, mastic, gaskets, or an IRC or ICC/IMC approved system.
P	P	**701.4.2.2**		**701.4.2.2 Ducts and Plenums.** Building framing cavities are not used as ducts or plenums.	None.
P	P	**701.4.2.3**		**701.4.2.3 Duct system sizing.** Duct system is sized and designed in accordance with ACCA Manual D or equivalent.	REQUIRED: Software output report for this building using ACCA Manual D or equivalent.
P	P	**701.4.3**		**701.4.3 Insulation and air sealing.**	
		701.4.3.1		**701.4.3.1 Building Thermal Envelope Air Sealing.** The building thermal envelope is durably sealed to limit infiltration. The sealing methods between dissimilar materials allow for differential expansion and contraction. The following are caulked, gasketed, weather-stripped or otherwise sealed with an air barrier material, suitable film, or solid material:	Drawing, specifications, scopes of work detailing air sealing that is not readily inspected during the rough inspection.
			(a)	All joints, seams and penetrations.	
			(b)	Site-built windows, doors, and skylights.	
			(c)	Openings between window and door assemblies and their respective jambs and framing.	
			(d)	Utility penetrations.	
			(e)	Dropped ceilings or chases adjacent to the thermal envelope.	
			(f)	Knee walls.	
			(g)	Walls, ceilings, and floors separating conditioned spaces from unconditioned.	
			(h)	Behind tubs and showers on exterior walls.	
			(i)	Common walls between dwelling units or sleeping units.	
			(j)	Attic access openings.	
			(k)	Joints of framing members at rim joists.	
			(l)	Top and bottom plates.	
			(m)	Other sources of infiltration.	
P	P	**701.4.3.2**		**701.4.3.2 Air barrier, air sealing, building envelope testing, and insulation.** Building envelope air barrier, air sealing envelope tightness, and insulation installation is verified to be in accordance with this Section and Section 701.4.3.2.1. Insulation installation other than Grade 1 is not permitted.	
P	P		**(1)**	**Testing.** Building envelope tightness is tested. Testing is conducted in accordance with ASTM E-779 using a blower door at a test pressure of 1.04 psf (50 Pa). Testing is conducted after rough-in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances. Testing is conducted under the following conditions:	Blower door report by qualified professional, signed by the party conducting the test.
			(a)	Exterior windows and doors, fireplace and stove doors are closed, but not sealed;	
			(b)	Dampers are closed, but not sealed, including exhaust, intake, makeup air, backdraft and flue dampers;	
			(c)	Interior doors are open;	
			(d)	Exterior openings for continuous ventilation systems and heat recovery ventilators are closed and sealed;	
			(e)	Heating and cooling systems are turned off;	
			(f)	HVAC duct terminations are not sealed; and	
			(g)	Supply and return registers are not sealed.	
				Multifamily Building Note: Testing by dwelling units, sleeping units, groups of dwelling units, groups of sleeping units, or the building as a whole is acceptable.	
P	P		**(2)**	**Visual inspection.** The air barrier and insulation items listed in Table 701.4.3.2(2) are field verified by visual inspection. See Table 701.4.3.2(2)	COMCheck Envelope Compliance report.
P	P	**701.4.3.2.1**		**701.4.3.2.1 Grade I insulation installations.** Field-installed insulation products to ceilings, walls, floors, band joists, rim joists, conditioned attics, basements, and crawlspaces, except as specifically noted, are verified as Grade I by a third-party are in accordance with the following:	None.
			(1)	Inspection is conducted before insulation is covered.	
			(2)	Air-permeable insulation is enclosed on all six sides and is in substantial contact with the sheathing material on one or more sides (interior or exterior) of the cavity. Air permeable insulation in ceilings is not required to be enclosed when the insulation is installed in substantial contact with the surfaces it is intended to insulate.	
			(3)	Cavity insulation uniformly fills each cavity side-to-side and top-to-bottom, without substantial gaps or voids around obstructions (such as blocking or bridging).	
			(4)	Cavity insulation compression or incomplete fill amounts to 2 percent or less, presuming the compressed or incomplete areas are a minimum of 70 percent of the intended fill thickness; occasional small gaps are acceptable.	
			(5)	Exterior rigid insulation has substantial contact with the structural framing members or sheathing materials and is tightly fitted at joints.	
			(6)	Cavity insulation is split, installed, and/or fitted tightly around wiring and other services.	
			(7)	Exterior sheathing is not visible from the interior through gaps in the cavity insulation.	
			(8)	Faced batt insulation is permitted to have side-stapled tabs, provided the tabs are stapled neatly with no buckling, and provided the batt is compressed only at the edges of each cavity, to the depth of the tab itself.	
			(9)	Where properly installed, ICFs, SIPs, and other wall systems that provide integral insulation are deemed in compliance with this section.	
P	P	**701.4.3.3**		**701.4.3.3 Multifamily air leakage alternative.** Multifamily buildings four or more stories in height and in compliance with IECC section C402.5 (Air leakage-thermal envelope) are deemed to comply with Sections 701.4.3.1 and 701.4.3.2.	COMcheck.
P	P	**701.4.3.4**		**701.4.3.4 Fenestration air leakage.** Windows, skylights and sliding glass doors have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m2), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m2), when tested in accordance with NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled. For site-built fenestration, a test report by an accredited, independent laboratory verifying compliance with the applicable infiltration rate shall be submitted to demonstrate compliance with this practice. This practice does not apply to field-fabricated fenestration products. **Exception:** For Tropical Zones Only, Jalousie windows are permitted to be used as a conditioned space boundary and shall have an air infiltration rate of not more than 1.3 cfm per square foot.	Manufacturer's label or literature indicating listing complying with this practice.
P	P	**701.4.3.5**		**701.4.3.5 Lighting in building thermal envelope.** Luminaires installed in the building thermal envelope which penetrate the air barrier are sealed to limit air leakage between conditioned and	Manufacturer's literature stating compliance with the practice.

P	P		unconditioned spaces. All luminaires installed in the building thermal envelope which penetrate the air barrier are IC-rated and labeled as meeting ASTM E283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity. All luminaires installed in the building thermal envelope which penetrate the air barrier are sealed with a gasket or caulk between the housing and the interior of the wall or ceiling covering.	
P	P	701.4.4	**701.4.4 High-efficacy lighting.** Lighting efficacy in dwelling units or sleeping units is in accordance with one of the following:	None.
		(1)	A minimum of 75 percent of the total hard-wired lighting fixtures or the bulbs in those fixtures qualify as high efficacy or equivalent	
		(2)	Lighting power density, measured in watts/square foot, is 1.1 or less.	
		701.4.5	**701.4.5 Boiler piping.** Boiler piping in unconditioned space supplying and returning heated water or steam is insulated.	None.
P	P	**702 PERFORMANCE PATH**		
		702.1	**702.1 Point allocation.** Points from Section 702 (Performance Path) shall not be combined with points from Section 703 (Prescriptive Path) or Section 704 (ERI Target Path).	
		702.2	**702.2 Energy performance levels.**	
		702.2.1	**702.2.1 ICC IECC analysis.** Energy efficiency features are implemented to achieve energy cost or source energy performance that meets the ICC IECC. A documented analysis using software in accordance with ICC IECC, Section R405, or ICC IECC Section C407.2 through C407.5, applied as defined in the ICC IECC, is required.	Energy performance report showing energy savings levels above ICC IECC. See Energy Efficiency Modeling Policy in VRG Part I for details on eligible software and accepted approaches. For multifamily projects employing building average or unit-by-unit modeling approaches, submit analysis showing the units modeled and corresponding performance. This can be submitted as an Excel table or another file format.
		702.2.2	**702.2.2 Energy performance analysis.** Energy savings levels above the ICC IECC are determined through an analysis that includes improvements in building envelope, air infiltration, heating system efficiencies, cooling system efficiencies, duct sealing, water heating system efficiencies, lighting, appliances, and on-site renewable energy. Points are assigned using the following formula: **Points = 30 + (percent above NGBS Reference Home) * 2** Multifamily Building Note: Modeling is completed building-wide using one of the following methods: whole building energy modeling, a unit-by-unit approach, or a building average of a unit-by-unit approach.	Energy performance report showing energy savings levels above ICC IECC. See Energy Efficiency Modeling Policy in VRG Part I for details on eligible software and accepted approaches. For multifamily projects employing building average or unit-by-unit modeling approaches, submit analysis showing the units modeled and corresponding performance. This can be submitted as an Excel table or another file format. The 2018 IECC sets the baseline performance for this analysis, however, the building does NOT have to be 2018 IECC compliant to be 2020 NGBS compliant. Ekotrope has a 2020 NGBS Green report that demonstrates compliance with this practice. RemRate is working on developing a 2020 NGBS report.
		702.2.3	**702.2.3 Tropical standard reference design.** For the Tropical Climate Zone, the standard reference design shall use the specifications in IECC Section R401.2.1 (Tropical Zone).	Energy analysis report.
P	P	**703 PRESCRIPTIVE PATH**		
		703.1	**703.1 Mandatory practices.**	
		703.1.1	**703.1.1 Building thermal envelope compliance.** The building thermal envelope is in compliance with Section 703.1.1.1 or 703.1.1.2. Exception: Section 703.1.1 is not required for Tropical Climate Zone.	RESCheck or COMCheck Envelope Compliance report or other equivalent analysis method showing the percent improvement for UA improvement over an analysis using the values provided in Table 703.1.1(a).
		703.1.1.1	**703.1.1.1 Maximum UA and SHGC.** For IECC residential buildings, the total building UA is less than or equal to the total maximum UA as computed by ICC IECC Section R402.1.5. The SHGC requirements for fenestration in Table R402.1.2 are also met. For IECC commercial buildings, the total UA is less than or equal to the sum of the UA for ICC IECC Tables C402.1.4 and C402.4, including the U-factor times the area and C-factor or F-factor times the perimeter. The SHGC requirements for fenestration in Table C402.4 are also met. The total UA proposed and baseline calculations are documented. REScheck or COMcheck is deemed to provide UA calculation documentation.	RESCheck or COMCheck or other equivalent analysis method demonstrating compliance.
		703.1.1.2	**703.1.1.2 Prescriptive R-values and fenestration requirements**. The building thermal envelope is in accordance with the insulation and fenestration requirements of ICC IECC Table R402.1.2 or Tables C402.1.3. The fenestration U-factors and SHGC's are in accordance with Table 703.2.5.1 or ICC IECC Table C402.4.	None.
		703.1.2	**703.1.2 Building envelope leakage.** The building thermal envelope is in accordance with ICC IECC R402.4.1.2 or C402.5 as applicable. Exception: Section 703.1.2 is not required for Tropical Climate Zone	R402.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8 if using ACH50 or 0.33 ELR for Climate Zones 1 and 2 and 0.23 for Climate Zones 3 through 8 if using the ELR method. Testing shall be conducted with a blower door at a pressure of 0.2 in. w.g. (50 Pa). For C402.5 testing, buildings that are 4+ stories shall be tested and verified as having an air leakage rate not exceeding 0.40 cfm/sq ft when testing at 75 Pa.
		703.1.3	**703.1.3 Duct Testing.** The duct system is in accordance with IECC R403.3.2 through R403.3.5 as applicable.	Duct leakage report.
		703.2	**703.2 Building envelope**	
		703.2.1	**703.2.1 UA improvement.** The total building thermal envelope UA is less than or equal to the baseline total UA resulting from the U-factors provided in Table 703.2.1(a) or ICC IECC Tables C402.1.4 and C402.4, as applicable. Where insulation is used to achieve the UA improvement, the insulation installation is in accordance with Grade 1 meeting Section 701.4.3.2.1 as verified by a third-party. Total UA is documented using a RESCheck, COMCheck, or equivalent report to verify the baseline and the UA improvement. See Table 703.2.1(a)	RESCheck 4.0.1 or other equivalent analysis method showing the percent improvement for UA improvement over an analysis using the values provided in Table 703.2.1(a). Documentation of 3rd party insulation installation grading results.
		703.2.2	**703.2.2 Mass walls.** More than 75 percent of the above-grade exterior opaque wall area of the building is mass walls.	None.
		703.2.3	**703.2.3** A radiant barrier with an emittance of 0.05 or less is used in the attic. The product is tested in accordance with ASTM C1371 and installed in accordance with the manufacturer's instructions.	Manufacturer's literature indicating conformance to ASTM C1371.
		703.2.4	**703.2.4 Building envelope leakage**. The maximum building envelope leakage rate is in accordance with Table 703.2.4a or Table 703.2.4b and whole building ventilation is provided in accordance with Section 902.2.1.	Test report showing ACH50 or ELR50.
		703.2.5	**703.2.5 Fenestration**	
		703.2.5.1	**703.2.5.1** NFRC-certified (or equivalent) U-factor and SHGC of windows, exterior doors, skylights, and tubular daylighting devices (TDDs) on an area-weighted average basis do not exceed the values in Table 703.2.5.1. Area weighted averages are calculated separately for the categories of 1) windows and exterior doors and 2) skylights and tubular daylighting devices (TDDs). Decorative fenestration elements with a combined total maximum area of 15 square feet (1.39 m2) or 10 percent of the total glazing area, whichever is less, are not required to comply with this practice. See Table 703.2.5.1	Labels on units.
		703.2.5.1.1	**703.2.5.1.1 Dynamic glazing.** Dynamic glazing is permitted to satisfy the SHGC requirements of Table 703.2.5.1 provided the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4 and the dynamic glazing is automatically controlled to modulate the amount of solar gain	Labels on units.

		into the space in multiple steps. Fenestration with dynamic glazing is considered separately from other fenestration and area-weighted averaging with fenestration that does not use dynamic glazing is not permitted. Dynamic glazing is not required to be automatically controlled or comply with minimum SHGC ratio when both the lower and higher labeled SHGC already comply with the requirements of Table 703.2.5.1.	
703.2.5.2		**703.2.5.2** The NFRC-certified (or equivalent) U-factor and SHGC of windows, exterior doors, skylights, and tubular daylighting devices (TDDs) are in accordance with Table 703.2.5.2(a), (b), or (c). Decorative fenestration elements with a combined total maximum area of 15 square feet (1.39 m^2) or 10 percent of the total glazing area, whichever is less, are not required to comply with this practice.	Labels on units.
	(a)	Table 703.2.5.2(a)	
	(b)	Table 703.2.5.2(b)	
	(c)	Table 703.2.5.2(c)	
703.2.5.2.1		**703.2.5.2.1 Dynamic glazing.** Dynamic glazing is permitted to satisfy the SHGC requirements of Tables 703.2.5.2(a), 703.2.5.2(b), and 703.2.5.2(c) provided the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4, and the dynamic glazing is automatically controlled to modulate the amount of solar gain into the space in multiple steps. Fenestration with dynamic glazing is considered separately from other fenestration, and area-weighted averaging with fenestration that does not use dynamic glazing is not permitted. Dynamic glazing is not required to be automatically controlled or comply with minimum SHGC ratio when both the lower and higher labeled SHGC already comply with the requirements of Tables 703.2.5.2(a), 703.2.5.2(b), and 703.2.5.2(c).	Labels on units.
703.3		**HVAC equipment efficiency**	
703.3.0		**703.3.0 Multiple heating and cooling systems.** For multiple heating or cooling systems in one home, practices 703.3.1 through 703.3.6 apply to the system that supplies 80% or more of the total installed heating or cooling capacity. Where multiple systems each serve less than 80% of the total installed heating or cooling capacity, points under Sections 703.3.1 through 703.3.6 are awarded either for the system eligible for the fewest points or the weighted average of the systems. The weighted average shall be calculated in accordance with the following equation and be based upon the efficiency and capacity of the equipment as selected in accordance with ACCA Manual S with it loads calculated in accordance with ACCA Manual J. Weighted Average = $[(E_{unit\ 1}*C_{unit\ 1})+(E_{unit\ 2}*C_{unit\ 2})+\ldots+(E_{unit\ n}*C_{unit\ n})] / (C_{unit\ 1}+C_{unit\ 2}+\ldots+C_{unit\ n})$ where: E = Rated AHRI efficiency for unit C = Rated heating or cooling capacity for unit *n* = Unit count	
703.3.1		**703.3.1** Combination space heating and water heating system (combo system) is installed using either a coil from the water heater connected to an air handler to provide heat for the building, dwelling unit or sleeping unit, or a space heating boiler using an indirect-fired water heater. Devices have a minimum combined annual efficiency of 0.80 and a minimum water heating recovery efficiency of 0.87.	Manufacturer's specification for combo system showing combined annual efficiency of at least 0.80 and a minimum water heating recovery efficiency of 0.87.
703.3.2		**703.3.2** Furnace and/or boiler efficiency is in accordance with one of the following:	Manufacturer's specification for equipment that is installed.
	(1)	Gas and propane heaters: ≥90% AFUE ≥92% AFUE ≥94% AFUE ≥96% AFUE ≥98% AFUE	
	(2)	Oil furnace: ≥85% AFUE ≥90% AFUE	
	(3)	Gas boiler: ≥85% AFUE ≥90% AFUE ≥94% AFUE ≥96% AFUE	
	(4)	Oil boiler: ≥85% AFUE ≥90% AFUE	
703.3.3		**703.3.3** Heat pump heating efficiency is in accordance with Table 703.3.3(1) or Table 703.3.3(2) or Table 703.3.3(3). Refrigerant charge is verified for compliance with manufacturer's instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010.	Manufacturer's specification for equipment that is installed.
	(1)	Electric Heat Pump Heating ≥8.5 HSPF ≥9.0 HSPF ≥9.5 HSPF ≥10.0 HSPF ≥12.0 HSPF	
	(2)	Electric Heat Pump Heating for Multifamily Buildings Four or More Stories in Height	
	(3)	Gas Engine-Driven Heat Pump Heating (≥1.3 COP at 47°F)	
703.3.4		**703.3.4** Cooling efficiency is in accordance with Table 703.3.4(1) or Table 703.3.4(2). Refrigerant charge is verified for compliance with manufacturer's instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010.	Manufacturer's specification for equipment that is installed.
	(1)	Electric Air Conditioner and Heat Pump Cooling ≥15 SEER ≥17 SEER ≥19 SEER ≥21 SEER ≥25 SEER	
	(*)	Tropical Climate Zone: None of the occupied space is air conditioned and ceiling fans are provided for bedrooms and the largest space which is not used as a bedroom.	
	(2)	Gas Engine-Driven Heat Pump Cooling (≥1.2 COP at 95°F)	
703.3.5		**703.3.5** Water source cooling and heating efficiency is in accordance with Table 703.3.5. Refrigerant charge is verified for compliance with manufacturer's instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010. ≥15 SEER, ≥4.0 COP	Manufacturer's specification for equipment that is installed.
703.3.6		**703.3.6** Ground source heat pump is installed by a Certified Geothermal Service Contractor in accordance with Table 703.3.6. Refrigerant charge is verified for compliance with manufacturer's	Manufacturer's specification for equipment that is installed.

		instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010.	
		≥16 EER, ≥3.6 COP	
		≥24 EER, ≥4.3 COP	
		≥28 EER, ≥4.8 COP	
703.3.7		**703.3.7** ENERGY STAR, or equivalent, ceiling fans are installed.	Manufacturer's literature. For products to comply, it is not simply enough for them to have an ENERGY STAR label. The product must meet the ENERGY STAR product specifications in Chapter 14. Verifiers must ensure that the products/appliances installed meet these eligibility criteria.
		(Points awarded per building.)	
		Note for Tropical Climate Zone and Climate Zones 2B, 3B, and 4B: points awarded per fan where AC is not installed in the dwelling unit or sleeping unit (Max 8 points), and where points awarded in Section 703.3.8 for these specific climate zones, points shall not be awarded in Section 703.3.7	
		NOTE: For multi-unit buildings, each dwelling unit must comply to claim this point.	
703.3.8		**703.3.8** Whole-building or whole-dwelling unit or whole-sleeping unit fan(s) with insulated louvers and a sealed enclosure is installed.	None.
		(Points awarded per building.)	
		NOTE: For multi-unit buildings, each dwelling unit must have compliant whole-dwelling unit fans installed to claim these points.	
703.4		**703.4 Duct Systems**	
703.4.1		**703.4.1** All space heating is provided by a system(s) that does not include air ducts.	None.
		(No points awarded for multifamily buildings four or more stories in height.)	
703.4.2		**703.4.2** All space cooling is provided by a system(s) that does not include air ducts.	None.
		(No points awarded for multifamily buildings four or more stories in height.)	
703.4.3		**703.4.3** Ductwork is in accordance with all of the following:	None.
	(1)	Building cavities are not used as return ductwork.	
	(2)	Heating and cooling ducts and mechanical equipment are installed within the conditioned building space.	
	(3)	Ductwork is not installed in exterior walls.	
		(No points awarded for multifamily buildings four or more stories in height.)	
703.4.4		**703.4.4 Duct Leakage.** The entire central HVAC duct system, including air handlers and register boots, is tested by a third party for total leakage at a pressure differential of 0.1 inches w.g. (25 Pa) and maximum air leakage is equal to or less than 6 percent of the system design flow rate or 4 cubic feet per minute per 100 square feet of conditioned floor area.	3rd party duct leakage test report.
		(Points not awarded if points are taken under Section 705.6.2.3)	
	(1)	ductwork entirely outside the building's thermal envelope	
	(2)	ductwork entirely inside the building's thermal envelope	
	(3)	ductwork inside and outside the building's thermal envelope	
703.5		**703.5 Water heating system**	
703.5.1		**703.5.1** Water heater Uniform Energy Factor (UEF) is in accordance with the following:	Manufacturer's literature.
		Where multiple systems are used, points awarded based on the system with the lowest efficiency.	
		Water heater design is based on only 1 (one) water heater per dwelling unit, based on approved methods from IPC or ASPE or manufacturer specifications.	
		All table values are based on water heaters with medium water draws as defined by the US DOE text procedures (55 gallons per day).	
	(1)	Gas water heating	
	(a)	Storage Water Heater, Rated Storage Volume > 20 Gallons and ≤ 55 Gallons, Medium Water Draw	
		Energy Factor: 0.65 to <0.78	
		Energy Factor: ≥0.78	
	(b)	Storage Water Heater, Rated Storage Volume > 55 Gallons and ≤ 100 Gallons, Medium Water Draw	
	(c)	Storage Water Heater with Input Rate Greater than 75,000 Btu/h (Commercial)	
		Thermal Efficiency: 0.90 to < 0.95	
		Thermal Efficiency: ≥0.95	
	(d)	Storage Water Heater with Input Rate Greater than 75,000 Btu/H (Commercial), In Buildings with High-Capacity Service Water-Heating Systems (1,000,000 Btu/h or Greater)	
		Thermal Efficiency: 0.92 to < 0.95	
		Thermal Efficiency: ≥0.95	
	(e)	Instantaneous Water Heater, Rated Storage Volume < 2 Gallons and Input Rate of > 50,000 Btu/h, Medium Water Draw	
		Energy Factor: 0.89 to < 0.94	
		Energy Factor: ≥0.94	
	(2)	Electric water heating	
	(a)	Storage Water Heater, Rated Storage Volume ≥ 20 Gallons and ≤ 55 Gallons, Medium Water Draw	
		Energy Factor: 0.94 to <1.0	
		Energy Factor: 1.0 to <1.5	
		Energy Factor: 1.5 to <2.0	
		Energy Factor: 2.0 to <2.2	
		Energy Factor: 2.2 to <2.5	
		Energy Factor: 2.5 to <3.0	
		Energy Factor: ≥3.0	
	(b)	Storage Water Heater, Rated Storage Volume ≥ 55 Gallons and ≤ 120 Gallons, Medium Water Draw	
		Energy Factor: 2.2 to <2.5	
		Energy Factor: 2.5 to <3.0	
		Energy Factor: 3.0 to <3.5	
		Energy Factor: ≥3.5	
	(c)	Electric Tabletop Water Heating (Tabletop Water Heater, Rated Storage Volume ≥ 20 Gallons and ≤ 120 Gallons, Medium Water Draw)	
	(d)	Electric Instantaneous Water Heating (Instantaneous Electric Water Heater, Rated Storage Volume < 2 Gallons, Medium Water Draw)	
	(e)	Electric Grid Enabled Water Heating (Grid Enabled Storage Water Heater, Rated Storage Volume ≥ 75 Gallons, Medium Water Draw)	
	(3)	Oil water heating (Oil water heating, < 50 gallons, Medium water draw)	
703.5.2		**703.5.2** Desuperheater is installed by a qualified installer or is pre-installed in the factory.	Manufacturer's literature showing factory installation or invoice/statement of work by qualified installer.
703.5.3		**703.5.3** Drain-water heat recovery system is installed.	None.
		(Points awarded per building.)	

703.5.4		**703.5.4** Indirect-fired water heater storage tanks heated from boiler systems are installed.	None.
703.5.5		**703.5.5 Solar water heater.** SRCC (Solar Rating & Certification Corporation) OG 300 rated, or equivalent, solar domestic water heating system is installed. Solar Energy Factor (SEF) as defined by SRCC is in accordance with Table 703.5.5(a) and Table 703.5.5(b).	Manufacturer's literature for installed equipment.
	(a)	Storage Water Heater, Rated Storage Volume of Backup Water Heater is ≥ 0.1 Gallon and ≤ 55 Gallons, Medium Water Draw	
		SEF ≥ 1.3	
		SEF ≥ 1.51	
		SEF ≥ 1.81	
		SEF ≥ 2.31	
		SEF ≥ 3.01	
	(b)	Storage Water Heater, Rated Storage Volume of Backup Water Heater is >55 Gallons, Medium Water Draw	
		SEF ≥ 1.3	
		SEF ≥ 1.51	
		SEF ≥ 1.81	
		SEF ≥ 2.31	
		SEF ≥ 3.01	
703.6		**703.6 Lighting and appliances**	
703.6.1		**703.6.1 Hard-wired lighting.** Hard-wired lighting is in accordance with one of the following:	Manufacturer's literature or labels, or documentation demonstrating equivalent to ENERGY STAR requirements. For products to comply, it is not simply enough for them to have an ENERGY STAR label. The product must meet the ENERGY STAR product specifications in Chapter 14. Verifiers must ensure that the products/appliances installed meet these eligibility criteria.
	(1)	A minimum percent (*95%*) of the total hard-wired interior luminaires or lamps qualify as ENERGY STAR, DesignLights Consortium (DLC), or applicable equivalent.	
	(2)	A minimum of 80 percent of the exterior lighting wattage has a minimum efficacy of 61 lumens per watt or is solar-powered.	
	(3)	In multifamily buildings, common area lighting power density (LPD) is less than 0.51 Watts per square foot.	
703.6.2		**703.6.2 Appliances.** ENERGY STAR or equivalent appliance(s) are installed:	Manufacturer's literature or labels. For products to comply, it is not simply enough for them to have an ENERGY STAR label. The product must meet the ENERGY STAR product specifications in Chapter 14. Verifiers must ensure that the products/appliances installed meet these eligibility criteria.
	(1)	Refrigerator	
	(2)	Dishwasher	
	(3)	Washing machine	
		Multifamily Building Note: Washing machines in ALL units must comply.	
703.7		**703.7 Passive solar design**	
703.7.1		**703.7.1 Sun-tempered design.** Building orientation, sizing of glazing, and design of overhangs are in accordance with all of the following:	Window label or other documentation showing glazing.
	(1)	The long side (or one side if of equal length) of the building faces within 20 degrees of true south.	
	(2)	Vertical glazing area is between 5 and 7 percent of the gross conditioned floor area on the south face [also see Section 703.7.1(8)] and glazing U-factors meet Table 703.2.5.2(a).	
	(3)	Vertical glazing area is less than 2 percent of the gross conditioned floor area on the west face, and glazing meets Table 703.2.5.2(a).	
	(4)	Vertical glazing area is less than 4 percent of the gross conditioned floor area on the east face, and glazing meets Table 703.2.5.2(a).	
	(5)	Vertical glazing area is less than 8 percent of the gross conditioned floor area on the north face, and glazing meets Table 703.2.5.2(a).	
	(6)	Skylights, where installed, are in accordance with the following:	
	(a)	shades and insulated wells are used, and all glazing meets Table 703.2.5.2(a)	
	(b)	horizontal skylights are less than 0.5 percent of finished ceiling area	
	(c)	sloped skylights on slopes facing within 45 degrees of true south, east, or west are less than 1.5 percent of the finished ceiling area	
	(7)	Overhangs or adjustable canopies or awnings or trellises provide shading on south-facing glass for the appropriate climate zone in accordance with Table 703.7.1(7):	
		See Table 703.7.1(7)	
	(8)	The south face windows have a SHGC of 0.40 or higher.	
	(9)	Return air or transfer grilles/ducts are in accordance with Section 705.4.	
		Multifamily Building Note: The site is designed such that at least 40 percent of the multifamily dwelling or sleeping units have one south facing wall (within 15 degrees) containing at least 50 percent of glazing for entire unit, Effective shading is required for passive solar control on all south facing glazing. The floor area of at least 15 feet from the south facing perimeter glazing is massive and exposed to capture solar heat during the day and reradiate at night.	
703.7.2		**703.7.2 Window shading.** Automated solar protection or dynamic glazing is installed to provide shading for windows.	None.
703.7.3		**703.7.3 Passive cooling design.** Passive cooling design features are in accordance with three or more of the following:	When thermal mass is claimed provide calculation for ratio of exposed thermal mass to conditioned floor space.
		Points for three items:	
		Points for one additional item:	
	(1)	Exterior shading is provided on east and west windows using one or a combination of the following:	
	(a)	vine-covered trellises with the vegetation separated a minimum of 1 foot (305 mm) from face of building	
	(b)	moveable awnings or louvers	
	(c)	covered porches	
	(d)	attached or detached conditioned/unconditioned enclosed space that provides full shade of east and west windows (e.g., detached garage, shed, or building)	
	(2)	Overhangs are installed to provide shading on south-facing glazing in accordance with Section 703.7.1(7).	
		(Points not awarded if points are taken under Section 703.7.1.)	
	(3)	Windows and/or venting skylights are located to facilitate cross and stack effect ventilation.	
	(4)	Solar reflective roof or radiant barrier is installed in climate zones 1, 2, or 3 and roof material achieves a 3-year aged criteria of 0.50.	
	(5)	Internal exposed thermal mass is a minimum of three inches (76 mm) in thickness. Thermal mass consists of concrete, brick, and/or tile fully adhered to a masonry base or other masonry material in accordance with one or a combination of the following:	
	(a)	A minimum of 1 square foot (0.09 m^2) of exposed thermal mass of floor per 3 square feet (2.8	

				m^2) of gross finished floor area.	
			(b)	A minimum of 3 square feet (2.8 m^2) of exposed thermal mass in interior walls or elements per square foot (0.09 m^2) of gross finished floor area.	
		(6)		Roofing material is installed with a minimum 0.75 inch (19 mm) continuous air space offset from the roof deck from eave to ridge.	
		703.7.4		**703.7.4 Passive solar heating design**. In addition to the sun-tempered design features in Section 703.7.1, all of the following are implemented:	Calculations for ratio of south glazing to floor area and ratio of exposed thermal mass to conditioned floor space.
				Note: Points shall not be awarded in the Tropical Climate Zone.	
		(1)		Additional glazing, no greater than 12 percent, is permitted on the south wall. This additional glazing is in accordance with the requirements of Section 703.7.1.	
		(2)		Additional thermal mass for any room with south-facing glazing of more than 7 percent of the finished floor area is provided in accordance with the following:	
			(a)	Thermal mass is solid and a minimum of 3 inches (76 mm) in thickness. Where two thermal mass materials are layered together (e.g., ceramic tile on concrete base) to achieve the appropriate thickness, they are fully adhered to (touching) each other.	
			(b)	Thermal mass directly exposed to sunlight is provided in accordance with the following minimum ratios:	
			(i)	Above latitude 35 degrees: 5 square feet (0.465 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.	
			(ii)	Latitude 30 degrees to 35 degrees: 5.5 square feet (0.51 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.	
			(iii)	Latitude 25 degrees to 30 degrees: 6 square feet (0.557 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.	
			(c)	Thermal mass not directly exposed to sunlight is permitted to be used to achieve thermal mass requirements of Section 703.7.4 (2) based on a ratio of 40 square feet (3.72 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.	
		(3)		In addition to return air or transfer grilles/ducts required by Section 703.7.1(9), provisions for forced airflow to adjoining areas are implemented as needed.	
P	P	**704 ERI TARGET PATH**			
P	P	**704.1**		**704.1 ERI target compliance.** Compliance with the energy chapter shall be permitted to be based on the EPA National ERI Target Procedure for Energy Star Certified Homes. Points from Section 704 (ERI Target) shall not be combined with points from Section 702 (Performance Path) or Section 703 (Prescriptive Path).	National ERI Target Procedures for ENERGY STAR Certified Homes.
				Dwelling ratings shall be submitted to a Rating Certification Body approved by the Adopting Entity for calculating points under this section.	
P	P	**704.2**		**704.2 Point calculation.** Points for Section 704 shall be computed based on Step "1" of the EPA National ERI Target Procedure. Points shall be computed individually for each building as follows:	Point calculation using the EPA Procedure above.
				30 + (Number of National ERI Points less than EnergyStar National ERI Target for that building) * 2.	
P	P	**705 ADDITIONAL PRACTICES**			
P	P	**705.2**		**705.2 Lighting**	
P	P	**705.2.1**		**705.2.1 Lighting controls**	
				(Percentages for point thresholds are based on lighting not required for means of egress or security lighting as defined by local building codes.)	
		705.2.1.1		**705.2.1.1 Interior lighting.** In dwelling units or sleeping units, permanently installed interior lighting fixtures are controlled with an occupancy sensor, or dimmer:	None.
		(1)		50 percent to less than 75 percent of lighting fixtures.	
		(2)		A minimum of 75 percent of lighting fixtures.	
P	P	**705.2.1.2**		**705.2.1.2 Exterior lighting.** Photo or motion sensors are installed on 75 percent of outdoor lighting fixtures to control lighting.	Building plans.
		705.2.1.3		**705.2.1.3 Multifamily common areas.**	None.
		(1)		In a multifamily building, occupancy sensors, or dimmers are installed in common areas (except corridors and stairwells).	
			(a)	50 percent to less than 75 percent of lighting fixtures.	
			(b)	A minimum of 75 percent of lighting fixtures.	
		(2)		In a multifamily building, occupancy controls are installed to automatically reduce light levels in interior corridors and exit stairwells when the space is unoccupied. Light levels are reduced by:	
			(a)	50 percent to less than 75 percent or to local minimum requirements	
			(b)	A minimum of 75 percent	
		705.2.1.4		**705.2.1.4** In a multifamily building, occupancy controls are installed to automatically reduce light levels in garages and parking structures when the space is unoccupied. Light levels are reduced by:	None.
		(1)		50 percent to less than 75 percent or to local minimum requirements	
		(2)		A minimum of 75 percent	
		705.2.2		**705.2.2 TDDs and skylights.** A tubular daylighting device (TDD) or a skylight that meets the requirements of Table 703.2.5.2(a) is installed in rooms without windows.	None.
				(Points awarded per building.)	
		705.2.3		**705.2.3 Lighting outlets.** Occupancy sensors are installed for a minimum of 80 percent of hard-wired lighting outlets in the interior living space.	None.
P	P	**705.2.4**		**705.2.4 Recessed luminaires.** The number of recessed luminaires that penetrates the thermal envelope is less than 1 per 400 square feet (37.16 m^2) of total conditioned floor area and they are in accordance with Section **701.4.3.5**.	None.
		705.3		**705.3 Induction cooktop.** Induction cooktop is installed.	None.
P	P	**705.4**		**705.4 Return ducts and transfer grilles.** Return ducts or transfer grilles are installed in every room with a door. Return ducts or transfer grilles are not required for bathrooms, kitchens, closets, pantries, and laundry rooms.	None.
P	P	**705.5**		**705.5 HVAC design and installation**	
		705.5.1		**705.5.1** Meet one or both of the following:	Certificate. For (1) EPA currently recognizes two H-QUITOS, listed below: ACCA's Quality Assured Contractor Directory Advanced Energy's Credentialed Contractor Directory
		(1)		HVAC contractor is certified by the Air Conditioning Contractors of Americas Quality Assured Program (ACCA/QA) or by an EPA-recognized HVAC Quality Installation Training Oversight Organization (H-QUITO) or equivalent.	
		(2)		HVAC installation technician(s) is certified by North American Technician Excellence, Inc. (NATE) or equivalent.	
		705.5.2		**705.5.2** Performance of the heating and/or cooling system is verified by the HVAC contractor in accordance with all of the following:	Start-up checklist signed by contractor.
		(1)		Start-up procedure is performed in accordance with the manufacturer's instructions.	

			(2)	Refrigerant charge is verified by super-heat and/or sub-cooling method.	
			(3)	Burner is set to fire at input level listed on nameplate.	
			(4)	Air handler setting/fan speed is set in accordance with manufacturer's instructions.	
			(5)	Total airflow is within 10 percent of design flow.	
			(6)	Total external system static does not exceed equipment capability at rated airflow.	
P	P	705.5.3		**705.5.3** HVAC Design is verified by 3rd party as follows:	
			(1)	The ENERGY STAR HVAC Design and Rater Design Review Checklists are completed and correct.	Completed ENERGY STAR checklists.
P	P		(2)	HVAC Installation is inspected and conforms to HVAC design documents and plans.	HVAC design documents and plans.
P	P	705.6		**705.6 Installation and performance verification.**	
P	P	705.6.1		**705.6.1** Third-party on-site inspection is conducted to verify compliance with all of the following, as applicable. Minimum of two inspections are performed: one inspection after insulation is installed and prior to covering, and another inspection upon completion of the building. Where multiple buildings or dwelling units of the same model or sleeping units of the same model are built by the same builder, a representative sample inspection of a minimum of 15 percent of the buildings or dwelling units or sleeping units is permitted.	None.
P	P	705.6.2		**705.6.2 Testing.** Testing is conducted to verify performance:	
		705.6.2.1		**705.6.2.1 Air leakage validation of building or dwelling units or sleeping units.** A visual inspection is performed as described in 701.4.3.2(2) and air leakage testing is performed in accordance with ASTM E779 or ASTM E1827.	Blower door test report. 701.4.3.2 visual inspection report.
				(Points awarded only for buildings where building envelope leakage testing is not required by 2015 IECC.)	
				(Points not awarded if points are taken under Section 703.2.4)	
			(1)	A blower door test.	
			(2)	Third-party verification is completed.	
				NOTE: Specify name of person or company conducting blower door test in the assigned Notes area.	
		705.6.2.2		**705.6.2.2 HVAC airflow testing.** Balanced HVAC airflows are demonstrated by flow hood or other acceptable flow measurement tool by a third party. Test results are in accordance with the following:	Report signed by qualified 3rd party showing design and actual flows at each supply and return indicating compliance with balanced flow requirement.
			(1)	Measured flow at each supply and return register meets or exceeds the requirements in ACCA 5 QI-2010, Section 5.2.	
			(2)	Total airflow meets or exceeds the requirements in ACCA 5 QI-2010, Section 5.2.	
				NOTE: Specify name of person or company conducting HVAC airflow test in the assigned Notes area.	
		705.6.2.3		**705.6.2.3 HVAC duct leakage testing.** One of the following is achieved:	Testing report from a qualified third-party (see VRG Part I Testing Policy)
				(Points awarded only where these practices are not required by IECC.)	
				(Points not awarded if points are taken under Section 703.4.4)	
			(1)	Duct leakage is in accordance with IECC R403.3.3 and R403.3.4.	
			(2)	Duct leakage is in accordance with IECC R403.3.3 and R403.3.4, and testing is conducted by an independent third party.	
		705.6.3		**705.6.3 Insulating hot water pipes.** Insulation with a minimum thermal resistance (R-value) of at least R-3 is applied to the following, as applicable:	None.
				(Points awarded only where these practices are not required by IECC.)	
			(a)	piping 3/4-inch and larger in outside diameter	
			(b)	piping serving more than one dwelling unit or sleeping unit	
			(c)	piping located outside the conditioned space	
			(d)	piping from the water heater to a distribution manifold	
			(e)	piping located under a floor slab	
			(f)	buried piping	
			(g)	supply and return piping in recirculation systems other than demand recirculation systems	
		705.6.4		**705.6.4 Potable hot water demand re-circulation system.**	None.
		705.6.4.1		**705.6.4.1** Potable hot water demand re-circulation system is installed in a single-family unit.	
		705.6.4.2		**705.6.4.2** Potable hot water demand re-circulation system(s) that serves every unit in a multifamily building is installed in place of a standard circulation pump and control.	None.
P	P	705.7		**705.7** In multi-unit buildings, an advanced electric and fossil fuel submetering system is installed to monitor electricity and fossil fuel consumption for each unit. The device provides consumption information on a monthly or near real-time basis. The information is available to the occupants at a minimum on a monthly basis.	None.
P	P	**706 INNOVATIVE PRACTICES**			
		706.1		**706.1 Energy consumption control.** A whole-building or whole-dwelling unit or whole-sleeping unit device or system is installed that controls or monitors energy consumption.	Manufacturer's product specification(s).
			(1)	programmable communicating thermostat with the capability to be controlled remotely	
			(2)	energy-monitoring device or system	
			(3)	energy management control system	
			(4)	programmable thermostat with control capability based on occupant presence or usage pattern	
			(5)	lighting control system	
		706.2		**706.2 Renewable energy service plan.** Renewable energy service plan is provided as follows:	
			(1)	Builder selects a renewable energy service plan provided by the local electrical utility for interim (temporary) electric service, or purchases renewable energy certificates (RECs) to cover electricity used. The builder's local administrative office has renewable energy service or has otherwise been paired with RECs. Green-ecertified (or equivalent) is required for renewable electricity purchases.	Evidence (e.g., utility bills) builder has selected renewable energy service for both construction and local office for temporary electric service during construction.
			(2)	The buyer of the building selects one of the following renewable energy service plans provided by the utility prior to occupancy of the building with a minimum two-year commitment.	Service agreement that owner has selected renewable energy service plan for permanent service after completion.
			(a)	less than half of the dwelling's projected electricity and gas use is provided by renewable energy	
			(b)	half or more of the of the dwelling's projected electricity and gas use is provided by renewable energy	
		706.3		**706.3 Smart Appliances and Systems.** Smart appliances and systems are installed as follows:	Manufacturer's literature or label.
				Three to five smart appliances installed	

		Six or more smart appliances installed	
		(Items (7) and (8) are permitted to count as two appliances each for the purpose of awarding points.)	
		(where points awarded in Section 706.3, points shall not be awarded in Section 706.7 and 706.9)	
	(1)	Refrigerator	
	(2)	Freezer	
	(3)	Dishwasher	
	(4)	Clothes Dryer	
	(5)	Clothes Washer	
	(6)	Room Air Conditioner	
	(7)	HVAC Systems	
	(8)	Service Hot Water Heating Systems	
706.4		**706.4 Pumps.**	
706.4.1		**706.4.1** Pool, spa, and water features equipped with filtration pumps as follows:	Manufacturer's literature.
	(1)	Electronically controlled variable-speed pump(s) is installed (full load efficiency of 90 percent or greater).	
	(2)	Electronically controlled variable-speed pump(s) is installed (full load efficiency of 90 percent or greater) in a pool	
706.4.2		**706.4.2** Sump pump(s) with electrically commutated motors (ECMs) or permanent split capacitor (PSC) motors is installed (full load efficiency of 90 percent or greater).	Manufacturer's literature.
706.5		**706.5 On-site renewable energy system.** One of the following options is implemented	Manufacturer's literature or installer certification showing number of watts produced by installed system.
	(1)	Building is Solar-Ready in compliance with IECC Appendix A Solar Ready Provisions.	
	(2)	An on-site renewable energy system(s) is installed on the property.	
	(3)	An on-site renewable energy system(s) and a battery energy storage system are installed on the property.	
		[Points shall not be awarded in this section for solar thermal or geothermal systems that provide space heating, space cooling, or water heating, Points for these systems are awarded in Section 703.]	
		[Where onsite renewable energy is included in Section 702 Performance Path or 704 ERI Target Path, Section 706.5 shall not be awarded.]	
		[Points awarded in this section shall not be combined with points for renewable energy in another section of this chapter. The solar-ready zone roof area in #1 is area per dwelling unit. Points in item #2 and #3 shall be divided by the number of dwelling units.]	
		Multifamily Building Note: *Conditioned common area and non-residential space is excluded for the purpose of calculating number of units.*	
706.6		**706.6 Parking garage efficiency.** Structured parking garages are designed to require no mechanical ventilation for fresh air requirements.	None.
706.7		**706.7 Grid-interactive electric thermal storage system.** A grid-interactive electric thermal storage system is installed.	None.
	(1)	Grid-Interactive Water Heating System	
	(2)	Grid-Interactive Space Heating and cooling System	
		(where points awarded in Section 706.7, points shall not be awarded in Section 706.3 and 706.9)	
706.8		**706.8 Electrical vehicle charging station.** A Level 2 (208/240V 40-80 amp) or Level 3 electric vehicle charging station is installed on the building site. (Note: Charging station shall not be included in the building energy consumption.)	None.
706.9		**706.9 CNG vehicle fueling station.** A CNG vehicle residential fueling appliance is installed on the building site. The CNG fueling appliances shall be listed in accordance with ANSI/CSA NGV 5.1 and installed in accordance to the appliance manufacturer's installation instructions. (Note: The fueling appliance shall not be included in the building energy consumption.)	None.
706.10		**706.10 Automatic demand response.** Automatic demand response system is installed that curtails energy usage upon a signal from the utility or an energy service provider is installed.	Building plan review.
		(where points awarded in Section 706.10, points shall not be awarded in Section 706.3 and 706.7)	
706.11		**706.11 Grid-interactive battery storage system.** A grid-interactive battery storage system of not less than 6 kWh of available capacity is installed.	Building plan review.
706.12		**706.12 Smart ventilation.** A whole-building ventilation systems is installed with automatic ventilation controls to limit ventilation during periods of extreme temperature, extreme humidity, and/or during times of peak utility loads and is in accordance with the specifications of ASHRAE Standard 62.2-2010 Section 4.	Building plan review.
706.13		**706.13 Alternative refrigerant.** Use of the following in mechanical space cooling systems for dwellings.	None.
	(1)	Use alternative refrigerant with a GWP < 1000	
	(2)	Do not use refrigerants	
706.14		**706.14 Third-party utility benchmarking service.**	
	(1)	For a multifamily building, the owner has contracted with a third-party utility benchmarking service with at least five (5) years of experience in utility data management and analysis to perform a monthly analysis of whole-building energy and water consumption for a minimum of 1 year.	For (1) contract with benchmarking service at least 1 year in duration.
	(2)	The building owner commits to reporting energy data using U.S. Environmental Protection Agency's ENERGY STAR Portfolio Manager for a minimum of three years.	For (2) proof of a Portfolio Manager account for the building.
706.15		**706.15 Entryway air seal.** For multifamily buildings, where not required by the building or energy code, to slow the movement of unconditioned air from outdoors to indoors at the main building entrance, the following is installed:	Building plan review.
	(1)	Building entry vestibule.	
	(2)	Revolving entrance doors.	
P	P	**801 INDOOR AND OUTDOOR WATER USE**	
801.0		**801.0 Intent.** Implement measures that reduce indoor and outdoor water usage. Implement measures that include collection and use of alternative sources of water. Implement measures that treat water on site.	
801.1		**801.1 Mandatory requirements.** The building shall comply with Section 802 (Prescriptive Path) and 803 (Innovative Practices) or Section 804 (Performance Path). Points from Section 804 (Performance Path) shall not be combined with points from Section 802 (Prescriptive Path) or	

			Section 803 (Innovative Practices). The mandatory provisions of Section 802 (Prescriptive Path) are required when using the Water Rating Index of Section 804 (Performance Path) for Chapter 8 Water Efficiency compliance.	
P	P		**802 PRESCRIPTIVE PATH**	
		802.1	**802.1 Indoor hot water usage.** Indoor hot water supply system is in accordance with one of the practices listed in items (1) through (5). The maximum water volume from the source of hot water to the termination of the fixture supply is determined in accordance with Tables 802.1(1) or 802.1(2). The maximum pipe length from the source of hot water to the termination of the fixture supply is 50 feet.	Calculation showing maximum amount of water in the piping between heater and any fixture.
			(Where more than one water heater is used or where more than one type of hot water supply system, including multiple circulation loops, is used, points are awarded only for the system that qualifies for the minimum number of points.)	
			(Systems with circulation loops are eligible for points only if pumps are demand controlled. Circulation systems with timers or aquastats and constant-on circulation systems are not eligible to receive points.)	
			(Points awarded only if the pipes are insulated in accordance with Section 705.6.3.)	
			See Table 802.1(1)	
			See Table 802.1(2)	
		(1)	The maximum volume from the water heater to the termination of the fixture supply at furthest fixture is 128 ounces (1 gallon or 3.78 liters).	
		(2)	The maximum volume from the water heater to the termination of the fixture supply at furthest fixture is 64 ounces (0.5 gallon or 1.89 liters).	
		(3)	The maximum volume from the water heater to the termination of the fixture supply at furthest fixture is 32 ounces (0.25 gallon or 0.945 liters).	
		(4)	A demand controlled hot water priming pump is installed on the main supply pipe of the circulation loop and the maximum volume from this supply pipe to the furthest fixture is 24 ounces (0.19 gallons or 0.71 liters).	
		(a)	The volume in the circulation loop (supply) from the water heater or boiler to the branch for the furthest fixture is no more than 128 ounces (1 gallon or 3.78 liters).	
		(5)	A central hot water recirculation system is implemented in multifamily buildings in which the hot water line distance from the recirculating loop to the engineered parallel piping system (i.e., manifold system) is less than 30 feet (9,144 mm) and the parallel piping to the fixture fittings contains a maximum of 64 ounces (1.89 liters) (115.50 cubic inches) (0.50 gallons).	
		(6)	Tankless water heater(s) with at least 0.5 gallon (1.89 liters) of storage are installed, or a tankless water heater that ramps up to at least 110F within 5 seconds is installed. The storage may be internal or external to the tankless water heater.	
		802.2	**802.2 Water-conserving appliances.** Energy Star or equivalent water-conserving appliances are installed.	For products to comply, it is not enough solely to have an ENERGY STAR label. The product must meet the ENERGY STAR product specifications in Chapter 14 REFERENCED DOCUMENTS. Verifiers must ensure that the products/appliances installed meet the program performance criteria.
P	P			
P	P			
		(1)	dishwasher	
		(2)	clothes washer, or	
		(3)	clothes washer with an Integrated Water Factor of 3.8 or less	
			NOTE: If multiple dishwashers and washing machines are installed, ALL instances must meet the above conditions to be awarded points.	
			Multifamily Building Note: Washing machines are installed in individual units or provided in common areas of multifamily buildings.	
		802.3	**802.3 Water usage metering.** Water meters are installed meeting the following:	Building plans.
		(1)	Single-Family Buildings: Water Usage Metering:	
		(a)	Where not otherwise required by the local AHJ, installation of a meter for water consumed from any source associated with the building or building site.	
		(b)	Each water meter shall be capable of communicating water consumption data remotely for the dwelling unit occupant and be capable of providing daily data with electronic data storage and reporting capability that can produce reports for daily, monthly, and yearly water consumption. (Fire sprinkler systems are not required to be metered).	
		(2)	Multi-Family Buildings: Water Usage Metering: **(Points earned in Section 802.3(2) shall not exceed 50% of the total points earned for Chapter 8)**	
		(a)	Where not otherwise required by the local AHJ, installation of a meter for water consumed from any source associated with the building or building site.	
		(b)	Each water meter shall be capable of communicating water consumption data remotely for the dwelling unit occupant and be capable of providing daily data with electronic data storage and reporting capability that can produce reports for daily, monthly, and yearly water consumption. (Fire sprinkler systems are not required to be metered).	
P	P	**802.4**	**802.4 Showerheads.** Showerheads are in accordance with the following:	Manufacturer's specifications showing compliance.
		(1)	The total maximum combined flow rate of all showerheads in a shower compartment with floor area of 2600 square inches or less is equal or less than 2.0 gpm. For each additional 1300 square inches or any portion thereof of shower compartment floor area, an additional 2.0 gpm combined showerhead flow rate is allowed. Showerheads shall comply with ASME A112.18.1/CSA B125.1 and shall meet the performance criteria of the U.S. EPA WaterSense Specification for showerheads. Showerheads shall be served by an automatic compensating valve that complies with ASSE 1016/ASME A112.1016/CSA B125.16 or ASME A112.18.1/CSA B125.1 and specifically designed to provide thermal shock and scald protection at the flow rate of the showerhead.	
			(Points awarded per shower compartment. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)	
		(2)	All shower compartments in the dwelling unit(s) or sleeping unit(s) and common areas meet the requirements of 802.4(1) and all showerheads are in accordance with one of the following:	
		(a)	maximum of 1.8 gpm	
		(b)	maximum of 1.5 gpm	
		(3)	Any shower control that can shut off water flow without affecting temperature is installed. **(Points awarded per shower control.)**	
P	P	**802.5**	**802.5 Faucets**	
P	P	**802.5.1**	**802.5.1** Install water-efficient lavatory faucets with flow rates not more than 1.5 gpm (5.68 L/m), tested in compliance with ASME A112.18.1/CSA B125.1 and meeting the performance criteria of the EPA WaterSense High-Efficiency Lavatory Faucet Specification:	Manufacturer's specifications showing compliance.
P	P			
P	P			
		(1)	Flow rate ≤ 1.5 gpm (*all faucets in a bathroom are in compliance)	

				(Points awarded for each bathroom. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)	
			(2)	Flow rate ≤ 1.2 gpm (*all faucets in a bathroom are in compliance)	
			(3)	Flow rate ≤ 1.5 gpm for all lavatory faucets in the dwelling unit(s) or sleeping unit(s)	
			(4)	Flow rate ≤ 1.5 gpm for all lavatory faucets in the dwelling unit(s), and at least one bathroom has faucets with flow rates ≤ 1.2 gpm	
			(5)	Flow rate ≤ 1.2 gpm for all lavatory faucets in the dwelling unit(s)	
		802.5.2		**802.5.2** Water-efficient residential kitchen faucets are installed in accordance with ASME A112.18.1/CSA B125.1. Residential kitchen faucets may temporarily increase the flow above the maximum rate but not to exceed 2.2 gpm.	Manufacturer's specifications showing compliance.
			(1)	All residential kitchen faucets have a maximum flow rate of 1.8 gpm.	
			(2)	All residential kitchen faucets have a maximum flow rate of 1.5 gpm.	
		802.5.3		**802.5.3** Self-closing valve, motion sensor, metering, or pedal-activated faucet is installed to enable intermittent on/off operation.	None.
				(Points awarded per fixture.)	
P	P	**802.5.4**		**802.5.4 Water closets and urinals.** Water closets and urinals are in accordance with the following:	Manufacturer's specifications or literature.
			(1)	Gold and emerald levels: All water closets and urinals are in accordance with Section 802.5.4.	
			(2)	A water closet is installed with an effective flush volume of 1.28 gallons (4.85 L) or less in accordance with ASME A112.19.2/CSA B45.1 or ASME A112.19.14 as applicable. Tank-type water closets shall be in accordance with the performance criteria of the U.S. EPA WaterSense Specification for Tank-Type Toilets.	
				(Points awarded per fixture. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)	
			(3)	All water closets are in accordance with Section 802.5.4(2).	
			(4)	All water closets are in accordance with Section 802.5.4(2) and one or more of the following are installed:	
			(a)	Water closets that have an effective flush volume of 1.2 gallons or less.	
				(Points awarded per toilet. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)	
			(b)	One or more urinals with a flush volume of 0.5 gallons (1.9L) or less when tested in accordance with ASME A112.19.2/CSA B45.1.	
			(c)	One or more composting or waterless toilets and/or nonwater urinals. Nonwater urinals shall be tested in accordance with ASME A112.19.2/CSA B45.1.	
P	P	**802.6**		**802.6 Irrigation systems**	Review irrigation plan and confirm prepared by qualified professional.
P	P	**802.6.1**		**802.6.1** Where an irrigation system is installed, an irrigation plan and implementation are executed by a qualified professional or equivalent.	
P	P				
		802.6.2		**802.6.2** Irrigation sprinkler nozzles shall be tested according to ANSI standard ASABE/ICC 802-2014 Landscape Irrigation Sprinkler and Emitter Standard by an accredited third party laboratory.	Manufacturer's literature.
		802.6.3		**802.6.3** Drip irrigation is installed.	None.
			(1)	Drip irrigation is installed for all landscape beds.	
			(2)	Subsurface drip is installed for all turf grass areas.	
			(3)	Drip irrigation zones specifications show plant type by name and water use/need for each emitter (Points awarded only if specifications are implemented.)	
		802.6.4		**802.6.4** The irrigation system(s) is controlled by a smart controller or no irrigation is installed.	Plan and statement from WaterSense professional indicating compliance.
				(Points are not additive.)	
			(1)	Irrigation controllers shall be in accordance with the performance criteria of the EPA WaterSense program	
			(2)	No irrigation is installed and a landscape plan is developed in accordance with Section 503.5, as applicable.	
				NOTE: 5 Points must be taken in 503.5(1)-(7) for a Full Landscape Plan in order to receive points for 802.6.4(3).	
		802.6.5		**802.6.5 Commissioning and water use reduction for irrigation systems.** *[Points are not additive per each section.]*	Written report from a qualified water commissioning agent that the irrigation system meets any of the above practices.
			(1)	All irrigation zones utilize pressure regulation so emission devices (sprinklers and drip emitters) operate at manufacturer's recommended operating pressure.	
			(2)	Where dripline tubing is installed, a filter with mesh size in accordance with the manufacturer's recommendation is installed on all drip zones.	
			(3)	Utilize spray bodies that incorporate an in-stem or external flow shut-off device.	
			(4)	For irrigation systems installed on sloped sites, either an in-stem or external check valve is utilized for each spray body.	
			(5)	Where an irrigation system is installed, a flow sensing device is installed to monitor and alert the controller when flows are outside design range.	
		802.7		**802.7 Rainwater collection and distribution.** Rainwater collection and distribution is provided.	
		802.7.1		**802.7.1** Rainwater is used for irrigation in accordance with one of the following:	Building and/or site plan.
			(1)	Rainwater is diverted for landscape irrigation without impermeable water storage	
			(2)	Rainwater is diverted for landscape irrigation with impermeable water storage in accordance with one of the following:	
			(a)	50 – 499 gallon storage capacity	
			(b)	500 – 2499 gallon storage capacity	
			(c)	2500 gallon or larger storage capacity (system is designed by a professional certified by The American Rainwater Catchment Systems Association or equivalent)	
			(d)	All irrigation demands are met by rainwater capture (documentation demonstrating the water needs of the landscape is provided and the system is designed by a professional certified by The American Rainwater Catchment Systems Association or equivalent).	
		802.7.2		**802.7.2** Rainwater is used for indoor domestic demand as follows. The system is designed by a professional certified by The American Rainwater Catchment Systems Association or equivalent.	None.
			(1)	Rainwater is used to supply an indoor appliance or fixture for any locally approved use.	Confirm system designed by qualified professional.
				(Points awarded per appliance or fixture.)	
			(2)	Rainwater provides for total domestic demand.	Analysis by qualified professional that system as installed and normal rainfall with provide 100% of domestic demand.
		802.8		**802.8 Sediment filters.** Water filter is installed to reduce sediment and protect plumbing fixtures	None.

				for the whole building or the entire dwelling unit.	
P	P	**802.9**		**802.9 Water treatment devices.**	
P	P	**802.9.1**		**802.9.1** Water Softeners shall not be installed where the supplied water hardness is less than 8.0 grains per gallon measured as total calcium carbonate equivalents. Water softeners shall be listed to NSF 44 and a rated salt efficiency of 3400 grains of total hardness per 1.0 pound of salt based on sodium chloride equivalency. Devices shall not discharge more than 4.0 gallons of water per 1000 grains of hardness removed during the service or recharge cycle.	Building plans.
			(1)	No water softener.	
			(2)	Water softener installed to supply softened water only to domestic water heater.	
P	P	**802.9.2**		**802.9.2** Reverse Osmosis (R/O) water treatment systems shall be listed to NSF 58 and shall include automatic shut-off valve to prevent water discharge when storage tank is full.	Manufacturer's specifications.
			(1)	No R/O system.	
			(2)	Combined capacity of all R/O systems does not exceed 0.75 gallons.	
		802.10		**802.10 Pools and spas.**	
		802.10.1		**802.10.1** Pools and Spas with water surface area greater than 36 square feet and connected to a water supply shall have a dedicated meter to measure the amount of water supplied to the pool or spa.	None.
			(1)	Automated motorized non-permeable pool cover that covers the entire pool surface.	
P	P	**803 INNOVATIVE PRACTICES**			
		803.1		**803.1 Reclaimed, gray, or recycled water**. Reclaimed, gray, or recycled water is used as permitted by applicable code.	
				(Points awarded for either Section 803.1(1) or 803.1(2), not both.)	
				(Points awarded for either Section 803.6 or 803.1, not both.)	
			(1)	each water closet flushed by reclaimed, gray, or recycled water **(Points awarded per fixture or appliance.)**	Confirm greywater reclaimed or recycled is compliant with IRC Appendix O and as permitted by local building code.
			(2)	irrigation from reclaimed, gray, or recycled water on-site	Confirm greywater reclaimed or recycled is compliant with IRC Appendix O and as permitted by local building code.
		803.2		**803.2 Reclaimed water, graywater, or rainwater pre-piping.** Reclaimed, graywater, or rainwater systems are rough plumbed (and permanently marked, tagged or labeled) into buildings for future use.	Plans and specs showing rough plumbed systems.
		803.3		**803.3 Automatic leak detection and control devices.** One of the following devices is installed. Where a fire sprinkler system is present, ensure the device will be installed to not interfere with the operation of the fire sprinkler system.	When fire sprinkler system present, provide installer's certification that shutoff does not interfere with sprinklers.
			(1)	automatic water leak detection and control devices	
			(2)	automatic water leak detection and shutoff devices	
		803.4		**803.4 Engineered biological system or intensive bioremediation system.** An engineered biological system or intensive bioremediation system is installed and the treated water is used on site. Design and implementation are approved by appropriate regional authority.	Local jurisdiction approval.
		803.5		**803.5 Recirculating humidifier.** Where a humidifier is required, a recirculating humidifier is used in lieu of a traditional "flow through" type.	None.
		803.6		**803.6 Advanced wastewater treatment system.** Advanced wastewater (aerobic) treatment system is installed and treated water is used on site.	Documentation describing advanced features of the system.
				(Points awarded for either Section 803.6 or 803.1, not both.)	
P	P	**804 PERFORMANCE PATH**			
		804.1		**804.1 Performance Path.** The index score for the Performance Path shall be calculated in accordance with Appendix D Water Rating Index (WRI) or equivalent methodology.	
		804.2		**804.2 Water efficiency rating levels.** In lieu of threshold levels for Chapter 8 in Table 303, rating levels for Section 804.1 are in accordance with Table 804.2.	
		804.3		**804.3 Water efficiency NGBS points equivalency.** The additional points for use with Table 303 from the Chapter 8 Water Efficiency Category are determined in accordance with equation 804.3.	See WRI VRG section for more details
				Equation 804.3	
				NGBS = WRI x (-2.29) + 181.7	
P	P	**901 POLLUTANT SORCE CONTROL**			
		901.0		**901.0 Intent.** Pollutant sources are controlled.	
P	P	**901.1**		**901.1 Space and water heating options**	
		901.1.1		**901.1.1** Natural draft furnaces, boilers, or water heaters are not located in conditioned spaces, including conditioned crawlspaces, unless located in a mechanical room that has an outdoor air source and is sealed and insulated to separate it from the conditioned space(s).	None.
				(Points are awarded only for buildings that use natural draft combustion space or water heating equipment.)	
		901.1.2		**901.1.2** Air handling equipment or return ducts are not located in the garage, unless placed in isolated, air-sealed mechanical rooms with an outside air source.	None.
				Not available if there is no attached garage	
		901.1.3		**901.1.3** The following combustion space heating or water heating equipment is installed within conditioned space:	None.
			(1)	all furnaces or all boilers	
			(a)	power vent furnace(s) or boiler(s)	
			(b)	direct vent furnace(s) or boiler(s)	
			(2)	all water heaters	
			(a)	power vent water heater(s)	
			(b)	direct vent water heater(s)	
P	P	**901.1.4**		**901.1.4** Gas-fired fireplaces and direct heating equipment is listed and is installed in accordance with the NFPA 54, ICC IFGC, or the applicable local gas appliance installation code. Gas-fired fireplaces within dwelling units or sleeping units and direct heating equipment are vented to the outdoors. Alcohol burning devices and kerosene heaters are vented to the outdoors.	Review manufacturer's literature to ensure they meet requirements.
		901.1.5		**901.1.5** Natural gas and propane fireplaces are direct vented, have permanently fixed glass fronts or gasketed doors, and comply with CSA Z21.88/CSA 2.33 or CSA Z21.50b/CSA 2.22b.	Manufacturer's literature.
P	P	**901.1.6**		**901.1.6** The following electric equipment is installed:	None.
			(1)	heat pump air handler in unconditioned space	
			(2)	heat pump air handler in conditioned space	
P	P	**901.2**		**901.2 Solid fuel-burning appliances**	
		901.2.1		**901.2.1** Solid fuel-burning fireplaces, inserts, stoves and heaters are code compliant and are in accordance with the following requirements:	
			(1)	Site-built masonry wood-burning fireplaces use outside combustion air and include a means of	None.

					sealing the flue and the combustion air outlets to minimize interior air (heat) loss when not in operation.	
			(2)		Factory-built, wood-burning fireplaces are in accordance with the certification requirements of UL 127 and are an EPA Phase 2 Emission Level Qualified Model.	Manufacturer's literature or label.
			(3)		Wood stove and fireplace inserts, as defined in UL 1482 Section 3.8, are in accordance with the certification requirements of UL 1482 and are in accordance with the emission requirements of the EPA Certification and the State of Washington WAC 173-433-100(3).	Manufacturer's literature or label.
			(4)		Pellet (biomass) stoves and furnaces are in accordance with ASTM E1509 or are EPA certified.	Manufacturer's literature or label.
			(5)		Masonry heaters are in accordance with the definitions in ASTM E1602 and ICC IBC Section 2112.1.	Manufacturer's literature or label.
P	P	**901.2.2**			**901.2.2** Fireplaces, woodstoves, pellet stoves, or masonry heaters are not installed.	None.
P	P	**901.3**			**901.3 Garages.** Garages are in accordance with the following:	
			(1)		Attached garage	
				(a)	Doors installed in the common wall between the attached garage and conditioned space are tightly sealed and gasketed.	None.
				(b)	A continuous air barrier is provided separating the garage space from the conditioned living spaces.	None.
				(c)	For one- and two-family dwelling units, a 100 cfm (47 L/s) or greater ducted or 70 cfm (33 L/s) cfm or greater unducted wall exhaust fan is installed and vented to the outdoors and is designed and installed for continuous operation or has controls (e.g., motion detectors, pressure switches) that activate operation for a minimum of 1 hour when either human passage door or roll-up automatic doors are operated. For ducted exhaust fans, the fan airflow rating and duct sizing are in accordance with ASHRAE Standard 62.2-2007 Section 7.3.	Manufacturer's literature/specifications for fan.
P	P		(2)		A carport is installed, the garage is detached from the building, or no garage is installed.	None.
		901.4			**901.4** Wood materials. A minimum of 85 percent of material within a product group (i.e., wood structural panels, countertops, composite trim/doors, custom woodwork, and/or component closet shelving) is manufactured in accordance with the following:	
P	P		(1)		Structural plywood used for floor, wall, and/or roof sheathing is compliant with DOC PS 1 and/or	None.
P	P				DOC PS 2. OSB used for floor, wall, and/or roof sheathing is compliant with DOC PS 2. The panels	
P	P				are made with moisture-resistant adhesives. The trademark indicates these adhesives as follows:	
P	P				Exposure 1 or Exterior for plywood, and Exposure 1 for OSB.	
					NOTE: If "N/A" is selected, please explain in the Notes area.	
P	P				Countertops	
P	P				Composite trim/doors	
P	P				Custom woodwork	
P	P				Component closet shelving	
P	P		(2)		Particleboard and MDF (medium density fiberboard) is manufactured and labeled in accordance	Manufacturer's literature or label on product.
P	P				with CPA A208.1 and CPA A208.2, respectively.	
P	P		(3)		Hardwood plywood in accordance with HPVA HP-1.	Manufacturer's literature or label on product.
P	P		(4)		Particleboard, MDF, or hardwood plywood is in accordance with CPA 4.	Manufacturer's literature or label on product.
P	P		(5)		Composite wood or agrifiber panel products contain no added urea-formaldehyde or are in	Manufacturer's literature or label on product.
P	P				accordance with the CARB *Composite Wood Air Toxic Contaminant Measure Standard* .	
P	P		(6)		Non-emitting products.	Manufacturer's literature or label on product.
		901.5			**901.5 Cabinets.** A minimum of 85 percent of installed cabinets are in accordance with one or both of the following:	
					(Where both of the following practices are used, only 3 points are awarded.)	
			(1)		All parts of the cabinet are made of solid wood or non-formaldehyde emitting materials such as metal or glass.	None.
			(2)		The composite wood used in wood cabinets is in accordance with CARB *Composite Wood Air Toxic Contaminant Measure Standard* or equivalent as certified by a third-party program such as, but not limited to, those in Appendix B.	Manufacturer's literature showing 3rd party certification.
P	P	**901.6**			**901.6 Carpets.** Wall-to-wall carpeting is not installed adjacent to water closets and bathing	None.
P	P				fixtures.	
		901.7			**901.7 Floor materials.** The following types of finished flooring materials are used. The materials have emission levels in accordance with CDPH/EHLB Standard Method v1.1. Product is tested by a laboratory with the CDPH/EHLB Standard Method v1.1 within the laboratory scope of accreditation to ISO/IEC 17025 and certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	
					(Points are awarded for every 10% of conditioned floor space using one of the below materials.)	
			(1)		Hard surface flooring: Prefinished installed hard-surface flooring is installed. Where post-manufacture coatings or surface applications have not been applied, the following hard surface flooring types are deemed to comply with the emission requirements of this practice:	None for materials the hard surface flooring listed above. Manufacturer's literature showing 3rd party certification for (2). Scope of work or specification showing products to be installed.
				(a)	Ceramic tile flooring	
				(b)	Organic-free, mineral-based flooring	
				(c)	Clay masonry flooring	
				(d)	Concrete masonry flooring	
				(e)	Concrete flooring	
				(f)	Metal flooring	
			(2)		Carpet meeting and carpet cushion not meeting the emission limits is installed.	Scope of work or specification showing products to be installed. Manufacturer's literature showing 3rd party certification.
			(3)		Carpet and carpet cushion meeting the emission limits is installed.	Scope of work or specification showing products to be installed. Manufacturer's literature showing 3rd party certification.
					(When carpet cushion meeting the emission limits of the practice is also installed, the percentage of compliant carpet area is calculated at 1.33 times the actual installed area.)	
		901.8			**901.8 Wall coverings.** A minimum of 10 percent of the interior wall surfaces are covered and a minimum of 85 percent of wall coverings are in accordance with the emission concentration limits of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	Manufacturer's literature showing 3rd party certification for other materials. Scope of work or specification showing products to be installed.
P	P	**901.9**			**901.9 Interior architectural coatings.** A minimum of 85 percent of the interior architectural	
P	P				coatings are in accordance with either Section 901.9.1 or Section 901.9.3, not both. A minimum	
P	P				of 85 percent of architectural colorants are in accordance with Section 901.9.2.	
P	P	**901.9.1**			**901.9.1** Site-applied interior architectural coatings, which are inside the water proofing	List of interior coatings used, amount used, %, and VOC criteria. Manufacturer's literature showing
P	P				envelope, are in accordance with one or more of the following:	VOC. Scopes of work or specifications showing which materials were to be used.
			(1)		Zero VOC as determined by EPA Method 24 (VOC content is below the detection limit for the method)	

			(2)	GreenSeal GS-11	
			(3)	CARB *Suggested Control Measure for Architectural Coatings* (see Table 901.9.1).	
				See Table 901.9.1	
		901.9.2		**901.9.2** Architectural coating colorant additive VOC content is in accordance with Table 901.9.2.	List of all colorants used, amount used, %, and VOC criteria. Manufacturer's literature showing VOC as listed. Scopes of work or specifications showing which materials were to be used.
				(Points for 901.9.2 are awarded only if base architectural coating is in accordance with 901.9.1.)	
				See Table 901.9.2	
		901.9.3		**901.9.3** Site-applied interior architectural coatings, which are inside the waterproofing envelope, are in accordance with the emission levels of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 in its scope of accreditation. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those found in Appendix B.	List of interior coatings used, amount used, %, and VOC criteria. Manufacturer's literature showing VOC and product certification. Scopes of work or specifications showing which materials were to be used.
P	P	901.10		**901.10 Interior adhesives and sealants.** A minimum of 85 percent of site-applied adhesives and sealants located inside the waterproofing envelope are in accordance with one of the following, as applicable.	List of all interior sealants used, amount, %, and VOC criteria. Manufacturer's literature showing VOC and product certification when applicable.
			(1)	The emission levels are in accordance with CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those found in Appendix B.	
			(2)	GreenSeal GS-36.	
			(3)	SCAQMD Rule 1168 in accordance with Table 901.10(3), excluding products that are sold in 16 ounce containers or less and are regulated by the California Air Resources Board (CARB) Consumer Products Regulations.	
				See Table 901.10(3)	
P	P	901.11		**901.11 Insulation.** Emissions of 85 percent of wall, ceiling, and floor insulation materials are in accordance with the emission levels of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation. Insulation is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	Manufacturer's literature or product marking showing compliance for wall, ceiling and/or floor insulation.
		901.12		**901.12 Furniture and Furnishings.** In a multifamily building, all furniture in common areas shall have VOC emission levels in accordance with ANSI/BIFMA e3-Furniture Sustainability Standard sections 7.6.1 and 7.6.2, tested in accordance with ANSI/BIFMA Standard Method M7.1.	Manufacturer's literature or product marking showing compliance.
P	P	901.13		**901.13 Carbon monoxide (CO) alarms.** A carbon monoxide (CO) alarm is provided in accordance with the IRC Section R315.	Manufacturer's literature or product marking showing compliance with UL 2034 and UL 217.
		901.14		**901.14 Building entrance pollutants control.** Pollutants are controlled at all main building entrances by one of the following methods:	None.
			(1)	Exterior grilles or mats are installed in a fixed manner and may be removable for cleaning.	
			(2)	Interior grilles or mats are installed in a fixed manner and may be removable for cleaning.	
		901.15		**901.15 Non-smoking areas.** Environmental tobacco smoke is minimized by one or more of the following:	None.
			(1)	All interior common areas of a multifamily building are designated as non-smoking areas with posted signage.	
			(2)	Exterior smoking areas of a multifamily building are designated with posted signage and located a minimum of 25 feet from entries, outdoor air intakes, and operable windows.	
P	P	**902 POLLUTANT CONTROL**			
		902.0		**902.0 Intent.** Pollutants generated in the building are controlled.	
P	P	902.1		**902.1 Spot ventilation.**	
		902.1.1		**902.1.1** Spot ventilation is in accordance with the following:	
P	P		(1)	Bathrooms are vented to the outdoors. The minimum ventilation rate is 50 cfm (23.6 L/s) for intermittent operation or 20 cfm (9.4 L/s) for continuous operation in bathrooms.	Manufacturer's literature/specifications for the fan showing cfm.
			(a)	A window complying with IRC Section R303.3 is provided in addition to mechanical ventilation.	
P	P		(2)	Clothes dryers (except listed and labeled condensing ductless dryers) are vented to the outdoors.	None.
			(3)	Kitchen exhaust units and/or range hoods are ducted to the outdoors and have a minimum ventilation rate of 100 cfm (47.2 L/s) for intermittent operation or 25 cfm (11.8 L/s) for continuous operation.	Manufacturer's literature/specifications showing cfm.
		902.1.2		**902.1.2** Bathroom and/or laundry exhaust fan is provided with an automatic timer and/or humidistat:	None.
			(1)	for first device	
			(2)	for each additional device	
		902.1.3		**902.1.3** Kitchen range, bathroom, and laundry exhaust are verified to air flow specification. Ventilation airflow at the point of exhaust is tested to a minimum of:	3rd party test report showing compliance as installed.
			(a)	100 cfm (47.2 L/s) intermittent or 25 cfm (11.8 L/s) continuous for kitchens, and	
			(b)	50 cfm (23.6 L/s) intermittent or 20 cfm (9.4 L/s) continuous for bathrooms and/or laundry	
		902.1.4		**902.1.4** Exhaust fans are ENERGY STAR, as applicable.	ENERGY STAR label or literature for basic fans or fans below 1 sone. For products to comply, it is not enough to have an ENERGY STAR label. The product must meet the ENERGY STAR product specifications in Chapter 14. Verifiers must ensure that the products/appliances installed meet these eligibility criteria.
P	P		(1)	ENERGY STAR, or equivalent, fans operating above 1 sone	
				(Points awarded per fan.)	
			(2)	ENERGY STAR, or equivalent, fans operating at or below 1 sone	
				(Points awarded per fan.)	
		902.1.5		**902.1.5** Fenestration in spaces other than those identified in 902.1.1 through 902.1.4 are designed for stack effect or cross-ventilation in accordance with all of the following:	None.
			(1)	Operable windows, operable skylights, or sliding glass doors with a total area of at least 15 percent of the total conditioned floor area are provided.	
			(2)	Insect screens are provided for all operable windows, operable skylights, and sliding glass doors.	
			(3)	A minimum of two operable windows or sliding glass doors are placed in adjacent or opposite walls. If there is only one wall surface in that space exposed to the exterior, the minimum windows or sliding glass doors may be on the same wall.	
		902.1.6		**902.1.6 Ventilation for Multifamily Common Spaces.** Systems are implemented and are in accordance with the specifications of ASHRAE 62.1 and an explanation of the operation and importance of the ventilation system is included in 1002.1 and 1002.2 of NGBS.	Review building plans and confirm that the calculations on the plan.

		902.2		**902.2 Building ventilation systems.**	
		902.2.1		**902.2.1** One of the following whole building ventilation systems is implemented and is in accordance with the specifications of ASHRAE Standard 62.2-2010 Section 4 and an explanation of the operation and importance of the ventilation system is **included in either 1001.1(9) or 1002.2(11)**.	Statement from qualified professional indicating system complies with ASHRAE Standard 62.2-2010 Section 4. To be compliant with "implementation" the system must be tested in accordance with 62.2. Confirm that relevant building manual includes explanation of the operation and importance of the ventilation system.
			(1)	exhaust or supply fan(s) ready for continuous operation and with appropriately labeled controls	
			(2)	balanced exhaust and supply fans with supply intakes located in accordance with the manufacturer's guidelines so as to not introduce polluted air back into the building	
			(3)	heat-recovery ventilator	
			(4)	energy-recovery ventilator	
			(5)	Ventilation air is preconditioned by a system not specified above	
		902.2.2		**902.2.2** Ventilation airflow is tested to achieve the design fan airflow in accordance with ANSI/RESNET/ICC 380 and Section 902.2.1.	Test report by qualified professional showing compliance as installed.
		902.2.3		**902.2.3** MERV filters 8 to 13 are installed on central forced air systems and are accessible. Designer or installer is to verify that the HVAC equipment is able to accommodate the greater pressure drop of MERV 8 to 13 filters.	Designer/installer certification of system capability for installed MERV filters.
		902.2.4		**902.2.4** MERV filters 14 or greater are installed on central forced air systems and are accessible. Designer or installer is to verify that the HVAC equipment is able to accommodate the greater pressure drop of the filter used.	Designer/installer certification of system capability for installed MERV filters.
P	P	902.3		**902.3 Radon reduction measures.** Radon reduction measures are in accordance with ICC IRC Appendix F or 902.3.1. Radon Zones as identified by the AHJ or, if the zone is not identified by the AHJ, as defined in Figure 9(1).	None for passive system. Plans/specifications for active systems.
			(1)	Buildings located in Zone 1	
			(a)	a passive radon system is installed	
			(b)	an active radon system is installed	
			(2)	Buildings located in Zone 2 or Zone 3	
			(a)	a passive radon system is installed	
			(b)	an active radon system is installed	
		902.3.1		**902.3.1 Radon reduction option.** This option requires section 902.3.2.1 through 902.3.2.7.	
		902.3.1.1		**902.3.1.1 Soil-gas barriers and base course.** A base course in accordance with Section 506.2.2 of the IRC shall be installed below slabs and foundations. There shall be a continuous gas-permeable base course under each soil-gas retarder that is separated by foundation walls or footings. Between slabs and the base course, damp proofing or water proofing shall be installed in accordance with Section 406 of the IRC. Punctures, tears and gaps around penetrations of the soil-gas retarder shall be repaired or covered with an additional soil-gas retarder. The soil-gas retarder shall be a continuous6-mil (0.15 mm) polyethylene or an approved equivalent.	
		902.3.1.2		**902.3.1.2 Soil gas collection.** There shall be an unobstructed path for soil gas flow between the void space installed in the base course and the vent through the roof. Soil gases below the foundation shall be collected by a perforated pipe with a diameter of not less than 4 inches (10 cm) and not less than 5 feet (1.5 m) in total length. A tee fitting or equivalent method shall provide two horizontal openings to the radon collection. The tee fitting shall be designed to prevent clogging of the radon collection path. Alternately the soil gas collection shall be by approved radon collection mats or an equivalent approved method.	
		902.3.1.3		**902.3.1.3 Soil gas entry routes.** Openings in slabs, soil-gas retarders, and joints such as, but not limited to, plumbing, ground water control systems, soil-gas vent pipes, piping and structural supports, shall be sealed against air leakage at the penetrations. The sealant shall be a polyurethane caulk, expanding foam or other approved method. Foundation walls shall comply with Section 103.2.3 of the IRC. Sumps shall be sealed in accordance with Section 103.2.2 of the IRC. Sump pits and sump lids intended for ground water control shall not be connected to the sub-slab soil-gas exhaust system.	
		902.3.1.4		**902.3.1.4 Soil gas vent.** A gas-tight pipe vent shall extend from the soil gas permeable layer though the roof. The vent pipe size shall not be reduced at any location as it goes from gas collection to the roof. Exposed and visible interior vent pipes shall be identified with not less than one label reading "Radon Reduction System" on each floor and in habitable attics.	
P	P	902.3.1.5		**902.3.1.5 Vent pipe diameter.** The minimum vent pipe diameter shall be as specified in Table 902.3.2.5.	Plans/specifications for radon system that meets above criteria. All criteria above must be met.
		902.3.1.6		**902.3.1.6 Multiple vented areas.** In dwellings where interior footings or other barriers separate the soil-gas permeable layer, each area shall be fitted with an individual vent pipe. Vent pipes shall connect to a single vent that terminates above the roof or each individual vent pipe shall terminate separately above the roof.	
		902.3.1.7		**902.3.1.7 Fan.** Each sub-slab soil-gas exhaust system shall include a fan, or dedicated space for the post-construction installation of a fan. The electrical supply for the fan shall be located within 6 feet (1.8 m) of the fan. Fan is not required to be on a dedicated circuit.	
P	P	902.3.2		**902.3.2 Radon testing.** Radon testing is mandatory for Zone 1.	Review completed radon test results and ensure that the result is included with the construction documents in the building manual. Verifier must confirm that radon test complies with all requirements of practice. Verifier must report radon test results in verification report. If the test result exceeds the maximum allowed, Verifier must confirm radon vent pipe fan is installed.
P	P			**Exceptions:**	
P	P			(2) Testing is not mandatory where the occupied space is located above an unenclosed open space.	
			(1)	Testing specifications. Testing is performance as specified in (a) through (j).	
			(a)	Testing is performed after the residence passes its airtightness test.	
			(b)	Testing is performed after the radon control system installation is complete. If the system has an active fan, the residence shall be tested with the fan operating.	
			(c)	Testing is performed at the lowest level within a dwelling unit which will be occupied, even if the space is not finished.	
			(d)	Testing is not performed in a closet, hallway, stairway, laundry room, furnace room, kitchen or bathroom.	
			(e)	Testing is performed with a commercially available test kit or with a continuous radon monitor that can be calibrated. Testing shall be in accordance with the testing device manufacturer's instructions.	
			(f)	Testing shall be performed by the builder, a registered design professional, or an approved third party.	
			(g)	Testing shall extend at least 48 hours or to the minimum specified by the manufacturer, which ever is longer.	
			(h)	Written radon test results shall be provided by the test lab or testing party. Written test results shall be included with construction documents.	
			(i)	An additional pre-paid test kit shall be provided for the homeowner to use when they choose. The test kit shall include mailing or emailing the results from the testing lab to the homeowner.	

			(j)	Where the radon test result is 4 pCi/L or greater, the fan for the radon vent pipe shall be installed.	
			(2)	Testing results. A radon test done in accordance with 902.3.1 and completed before occupancy receives a results of 2 pCi/L or less.	
P	P	902.4		**902.4 HVAC system protection.** One of the following HVAC system protection measures is performed.	
P	P		(1)	HVAC supply registers (boots), return grilles, and rough-ins are covered during construction activities to prevent dust and other pollutants from entering the system.	None.
P	P		(2)	Prior to owner occupancy, HVAC supply registers (boots), return grilles, and duct terminations are inspected and vacuumed. In addition, the coils are inspected and cleaned and the filter is replaced if necessary.	Invoice from cleaning contractor showing cleaning and coil inspection.
			(3)	If HVAC systems are to be operated, during construction, all return grilles have a temporary MERV 8 or higher filter installed in a manner ensuring no leakage around the filter.	None.
		902.5		**902.5 Central vacuum systems.** Central vacuum system is installed and vented to the outside.	None.
P	P	902.6		**902.6 Living space contaminants.** The living space is sealed in accordance with Section 701.4.3.1 to prevent unwanted contaminants.	None.
P	P	**903 MOISTURE MANAGEMENT: VAPOR, RAINWATER, PLUMBING, HVAC**			
		903.0		**903.0 Intent.** Moisture and moisture effects are controlled.	
P	P	903.1		**903.1 Plumbing.** Plumbing is in accordance with one of the following.	
P	P		(1)	Cold water pipes in unconditioned spaces are insulated to a minimum of R-4 with pipe insulation or other covering that adequately prevents condensation.	None.
P	P		(2)	Plumbing is not installed in unconditioned spaces.	None.
		903.2		**903.2 Duct insulation.** Ducts are in accordance with one of the following.	None.
			(1)	All HVAC ducts, plenums, and trunks are located in conditioned space.	
			(2)	All HVAC ducts, plenums, and trunks are in conditioned space. All HVAC ducts are insulated to a minimum of R4.	
		903.3		**903.3 Relative humidity.** In climate zones 1A, 2A, 3A, 4A, and 5A, equipment is installed to maintain relative humidity (RH) at or below 60 percent using one of the following:	Manufacturer's literature detailing capabilities. Statement by qualified professional that the system as installed has the capacity to meet the practice.
			(1)	additional dehumidification system(s)	
			(2)	central HVAC system equipped with additional controls to operate in dehumidification mode	
P	P	**904 INDOOR AIR QUALITY**			
		904.0		**904.0 Intent.** IAQ is protected by best practices to control ventilation, moisture, pollutant sources and sanitation.	
		904.1		**904.1 Indoor Air Quality (IAQ) During Construction.** Wood is dry before close-in (602.1.7.1(3)), materials comply with emission criteria (901.4- 901.11), sources of water infiltration or condensation observed during construction have been eliminated, accessible interior surfaces are dry and free of visible suspect growth (per ASTM D7338-10 section 6.3), and water damage (per ASTM D7338-10 section 7.4.3).	
P	P	904.2		**904.2 Indoor Air Quality (IAQ) Post Completion.** Verify there are no moisture, mold, and dust issues per 602.1.7.1(3), 901.4-901.11, ASTM D7338 Section 6.3, and ASTM D7338 Section 7.4.3.	None.
P	P	904.3		**904.3 Microbial growth & moisture inspection and remediation.** A visual inspection is performed to confirm the following:	None.
			(1)	Verify that no visible signs of discoloration and microbial growth on ceilings, walls or floors, or other building assemblies Or If minor microbial growth is observed (less than within a total area of 25 square feet) in homes or multifamily buildings, reference EPA Document 402-K-02-003 (A Brief Guide to Mold, Moisture, and Your Home) for guidance on how to properly remediate the issue. If microbial growth is observed, on a larger scale in homes or multifamily buildings (greater than 25 sq ft), reference EPA document 402-k-01-001 (Mold Remediation in Schools and Commercial Buildings) for guidance on how to properly remediate the issue.	
			(2)	Verify that there are no visible signs of water damage or pooling. If signs of water damage or pooling are observed, verify that the source of the leak has been repaired, and that damaged materials are either properly dried or replaced as needed.	
P	P	**905 INNOVATIVE PRACTICES**			
		905.1		**905.1 Humidity monitoring system.** A humidity monitoring system is installed with a mobile base unit that displays readings of temperature and relative humidity. The system has a minimum of two remote sensor units. One remote sensor unit is placed permanently inside the conditioned space in a central location, excluding attachment to exterior walls, and another remote sensor unit is placed permanently outside of the conditioned space.	None.
		905.2		**905.2 Kitchen exhaust.** A kitchen exhaust unit(s) that equals or exceeds 400 cfm (189 L/s) is installed, and makeup air is provided.	Manufacturer's literature showing cfm.
		905.3		**905.3 Enhanced air filtration.** Meet all of the following.	Review plans for location of secondary filter rack.
			(1)	Design for and install a secondary filter rack space for activated carbon filters.	
			(2)	Provide the manufacturer's recommended filter maintenance schedule to the homeowner or building manager.	
		905.4		**905.4 Sound barrier.** Provide room-to-room privacy between bedrooms and adjacent living spaces within dwelling units or homes by achieving an articulation index (AI) between 0 and 0.15 per the criteria below. *Articulation Index 0 to 0.05 = STC greater than 55 (NIC greater than 47)* *Articulation Index 0.05 to 0.15 = STC 52 to 55 (NIC 44 to 47)*	Building plans should confirm the intent to have a sound barrier that meets the criteria above.
		905.5		**905.5 Evaporative coil mold prevention.** For buildings with a mechanical system for cooling, ultraviolet lamps are installed on the cooling coils and drain pans of the mechanical system supplies. Lamps produce ultraviolet radiation at a wavelength of 254 nm so as not to generate ozone. Lamps have ballasts housed in a NEMA-rated enclosure.	Confirm on building plans and check manufacturer literature to confirm lamp enclosure is NEMA-rated.
P	P	**1001 HOMEOWNER'S MANUAL AND TRAINING GUIDELINES FOR ONE- AND TWO-FAN**			
		1001.0		**1001.0 Intent.** Information on the building's use, maintenance, and green components is provided.	
		1001.1		**1001.1** A homeowner's manual is provided and stored in a permanent location in the dwelling that includes the following, as available and applicable.	Verifier should review homeowner's manual that addresses the required 3 items and any of the listed additional optional items.
				(Points awarded per two items. Points awarded for non-mandatory items.)	
			(1)	A National Green Building Standard certificate with weblink and completion document.	
			(2)	List of green building features (can include the national green building checklist).	
			(3)	Product manufacturer's manuals or product data sheet for installed major equipment, fixtures,	

			and appliances. If product data sheet is in the building owners' manual, manufacturer's manual may be attached to the appliance in lieu of inclusion in the building owners' manual.	
		(4)	Maintenance checklist.	
		(5)	Information on local recycling and composting programs.	
		(6)	Information on available local utility programs that purchase a portion of energy from renewable energy providers.	
		(7)	Explanation of the benefits of using energy-efficient lighting systems [e.g., compact fluorescent light bulbs, light emitting diode (LED)] in high-usage areas.	
		(8)	A list of practices to conserve water and energy.	
		(9)	Information on the importance and operation of the home's fresh air ventilation system.	
		(10)	Local public transportation options.	
		(11)	A diagram showing the location of safety valves and controls for major building systems.	
		(12)	Where frost-protected shallow foundations are used, owner is informed of precautions including:	
		(a)	instructions to not remove or damage insulation when modifying landscaping.	
		(b)	providing heat to the building as required by the ICC IRC or IBC.	
		(c)	keeping base materials beneath and around the building free from moisture caused by broken water pipes or other water sources.	
		(13)	A list of local service providers that offer regularly scheduled service and maintenance contracts to ensure proper performance of equipment and the structure (e.g., HVAC, water-heating equipment, sealants, caulks, gutter and downspout system, shower and/or tub surrounds, irrigation system).	
		(14)	A photo record of framing with utilities installed. Photos are taken prior to installing insulation, clearly labeled, and included as part of the building owners' manual.	
		(15)	List of common hazardous materials often used around the building and instructions for proper handling and disposal of these materials.	
		(16)	Information on organic pest control, fertilizers, deicers, and cleaning products.	
		(17)	Information on native landscape materials and/or those that have low water requirements.	
		(18)	Information on methods of maintaining the building's relative humidity in the range of 30 percent to 60 percent.	
		(19)	Instructions for inspecting the building for termite infestation.	
		(20)	Instructions for maintaining gutters and downspouts and importance of diverting water a minimum of 5 feet away from foundation.	
		(21)	A narrative detailing the importance of maintenance and operation in retaining the attributes of a green-built building.	
		(22)	Where stormwater management measures are installed on the lot, information on the location, purpose, and upkeep of these measures.	
		(23)	Explanation of and benefits from green cleaning in the home.	
		(24)	Retrofit energy calculator that provides baseline for future energy retrofits.	
	1001.2		**1001. 2 Training of initial homeowners.** Initial homeowners are familiarized with the role of occupants in achieving green goals. Training is provided to the responsible party(ies) regarding equipment operation and maintenance, control systems, and occupant actions that will improve the environmental performance of the building. These include:	Builder's documented procedures & standard practices explaining the occupant training process. Examples of training materials and written confirmation from similar projects that training has been done.
		(1)	HVAC filters.	
		(2)	Thermostat operation and programming.	
		(3)	Lighting controls.	
		(4)	Appliances operation.	
		(5)	Water heater settings and hot water use.	
		(6)	Fan controls.	
		(7)	Recycling and composting practices.	
		(8)	Whole-dwelling mechanical ventilation systems.	
P	P	**1002 CONSTRUCTION, OPERATION, AND MAINTENANCE MANUALS AND TRAINING FOR MULTI-UNIT BUILDINGS**		
	1002.0		**1002.0 Intent.** Manuals are provided to the responsible parties (owner, management, tenant, and/or maintenance team) regarding the construction, operation, and maintenance of the building. Paper or digital format manuals are to include information regarding those aspects of the building's construction, maintenance, and operation that are within the area of responsibilities of the respective recipient. One or more responsible parties are to receive a copy of all documentation for archival purposes.	
P	P	**1002.1**	**1002.1 Building construction manual.** A building construction manual, including five or more of	Verifier must review building construction manual that addresses the mandatory 3 items (a certificate placeholder is acceptable) plus at least 2 of the listed additional optional items. Verify the expected process to deliver manual(s) to the responsible party.
P	P		the following, is compiled and distributed in accordance with Section 1002.0.	
P	P		**(Points awarded per two items. Points awarded for non-mandatory items.)**	
		(1)	A narrative detailing the importance of constructing a green building, including a list of green building attributes included in the building. This narrative is included in all responsible parties' manuals.	
		(2)	A local green building program certificate as well as a copy of the *National Green Building Standard™*, as adopted by the Adopting Entity, and the individual measures achieved by the building.	
		(3)	Warranty, operation, and maintenance instructions for all equipment, fixtures, appliances, and finishes.	
		(4)	Record drawings of the building.	
		(5)	A record drawing of the site including stormwater management plans, utility lines, landscaping with common name and genus/species of plantings.	
		(6)	A diagram showing the location of safety valves and controls for major building systems.	
		(7)	A list of the type and wattage of light bulbs installed in light fixtures.	
		(8)	A photo record of framing with utilities installed. Photos are taken prior to installing insulation and clearly labeled.	
P	P	**1002.2**	**1002.2 Operations manual.** Operations manuals are created and distributed to the responsible	Review the operations manual that includes both mandatory items and at least 2 from the list of optional items.
P	P		parties in accordance with Section 1002.0. Between all of the operation manuals, five or more of	
P	P		the following options are included.	
			(Points awarded per two items. Points awarded for non-mandatory items.)	
		(1)	A narrative detailing the importance of operating and living in a green building. This narrative is included in all responsible parties' manuals.	
		(2)	A list of practices to conserve water and energy (e.g., turning off lights when not in use, switching the rotation of ceiling fans in changing seasons, purchasing ENERGY STAR appliances and electronics).	
		(3)	Information on methods of maintaining the building's relative humidity in the range of 30	

				percent to 60 percent.	
			(4)	Information on opportunities to purchase renewable energy from local utilities or national green power providers and information on utility and tax incentives for the installation of on-site renewable energy systems.	
			(5)	Information on local and on-site recycling and hazardous waste disposal programs and, if applicable, building recycling and hazardous waste handling and disposal procedures.	
			(6)	Local public transportation options.	
			(7)	Explanation of the benefits of using compact fluorescent light bulbs, LEDs, or other high-efficiency lighting.	
			(8)	Information on native landscape materials and/or those that have low water requirements.	
			(9)	Information on the radon mitigation system, where applicable.	
			(10)	A procedure for educating tenants in rental properties on the proper use, benefits, and maintenance of green building systems including a maintenance staff notification process for improperly functioning equipment.	
			(11)	Information on the importance and operation of the building's fresh air ventilation system.	
P	P	**1002.3**		**1002.3 Maintenance manual.** Maintenance manuals are created and distributed to the responsible parties in accordance with Section 1002.0. Between all of the maintenance manuals, five or more of the following options are included.	Review the maintenance manual that addresses the mandatory item and at least 4 of the optional items.
P	P				
P	P				
				(Points awarded per two items. Points awarded for non-mandatory items.)	
			(1)	A narrative detailing the importance of maintaining a green building. This narrative is included in all responsible parties' manuals.	
			(2)	A list of local service providers that offer regularly scheduled service and maintenance contracts to ensure proper performance of equipment and the structure (e.g., HVAC, water-heating equipment, sealants, caulks, gutter and downspout system, shower and/or tub surrounds, irrigation system).	
			(3)	User-friendly maintenance checklist that includes:	
			(a)	HVAC filters	
			(b)	thermostat operation and programming	
			(c)	lighting controls	
			(d)	appliances and settings	
			(e)	water heater settings	
			(f)	fan controls	
			(4)	List of common hazardous materials often used around the building and instructions for proper handling and disposal of these materials.	
			(5)	Information on organic pest control, fertilizers, deicers, and cleaning products.	
			(6)	Instructions for maintaining gutters and downspouts and the importance of diverting water a minimum of 5 feet away from foundation.	
			(7)	Instructions for inspecting the building for termite infestation.	
			(8)	A procedure for rental tenant occupancy turnover that preserves the green features.	
			(9)	An outline of a formal green building training program for maintenance staff.	
			(10)	A green cleaning plan which includes guidance on sustainable cleaning products.	
			(11)	A maintenance plan for active recreation and play spaces (e.g., playgrounds, ground markings, exercise equipment.	
P	P	**1002.4**		**1002.4 Training of building owners.** Building owners are familiarized with the role of occupants in achieving green goals. On-site training is provided to the responsible party(ies) regarding equipment operation and maintenance, control systems, and occupant actions that will improve the environmental performance of the building. These include:	Builder's documented procedures & standard practices explaining the occupant training process. Examples of training materials and written confirmation from similar projects that training has been done.
P	P				
P	P				
P	P				
P	P				
			(1)	HVAC filters	
			(2)	thermostat operation and programming	
			(3)	lighting controls	
			(4)	appliances operation	
			(5)	water heater settings and hot water use	
			(6)	fan controls	
			(7)	recycling and composting practices	
			(8)	Whole-dwelling mechanical ventilation systems	
		1002.5		**1002.5 Multifamily occupant manual.** An occupant manual is compiled and distributed in accordance with Section 1002.0. *[Points awarded for non-mandatory items.]*	Review of the manual that addresses the mandatory items and the additional items for points.
			(1)	NGBS certificate	
			(2)	List of green building features	
			(3)	Operations manuals for all appliances and occupant operated equipment including lighting and ventilation controls, thermostats, etc.	
			(4)	Information on recycling and composting programs	
			(5)	Information on purchasing renewable energy from utility	
			(6)	Information on energy efficient replacement lamps	
			(7)	List of practices to save water and energy	
			(8)	Local public transportation options	
			(9)	Explanation of benefits of green cleaning	
P	P	**1002.6**		**1002.6 Training of multifamily occupants.** Prepare a training outline, video or website that familiarizes occupants with their role in maintaining the green goals of the project. Include all equipment that the occupant(s) is expected to operate including but not limited.	Review of training outline, video, or website for occupants.
P	P				
P	P				
P	P				
			(1)	Lighting controls	
			(2)	Ventilation controls	
			(3)	Thermostat operation and programming	
			(4)	Appliances operation	
			(5)	Recycling and composting	
			(6)	HVAC filters	
			(7)	Water heater setting and hot water use	
P	P	**1003 PUBLIC EDUCATION**			
		1003.0		**1003.0 Intent.** Increase public awareness of the National Green Building Standard and projects constructed in accordance with National Green Building Standard to help increase demand for high-performance homes.	
P	P	**1003.1**		**1003.1 Public Education.** One or more of the following is implemented:	Visual confirmation and/or photos of the construction signs visible on site during construction.
			(1)	**Signage.** Signs showing the project is designed and built in accordance with the National Green Building Standard are posted on the construction site.	
P	P		**(2)**	**Certification Plaques.** National Green Building Standard certification plaques with rating level	Purchase order for certification signage and written instructions regarding installation location.

P	P		attainted are placed in a conspicuous location near the utility area of the home or, in a conspicuous location near the main entrance of a multifamily building.	
P	P			
		(3)	**Education.** A URL for the National Green Building Standard is included on site signage, builder website (or property website for multifamily buildings), and marketing materials for homes certified under the National Green Building Standard.	Photos, screen shots of web pages, or copies of marketing materials that include www.ngbs.com.
P	P	**1004 POST OCCUPANCY PERFORMANCE ASSESSMENT**		
		1004.0	**1004.0 Intent.** A verification system for post occupancy assessment of the building is intended to be a management tool for the building owner to determine if energy or water usage have deviated from expected levels so that inspection and correction action can be taken.	
		1004.1	**1004.1** A verification system plan is provided in the building owner's manual (Sections 1001 or 1002). The verification system provides methods for demonstrating continued energy and water savings that are determined from the building's initial year of occupancy of water and energy consumption as compared to annualized consumption at least every four years.	
			(1) Verification plan is developed to monitor post-occupancy energy and water use and is provided in the building owner's manual.	Analysis or reports from appropriate building modeling software used during design by the design team to estimate expected annual energy and water use for the building. The expected energy and water use will set the performance baseline for the building and the calculations must be included in the building owner's manual. Building owner's manual must include a plan where actual energy and water use can be compared to the expected energy and water use. The plan must provide for measurement and verification of the energy and water use at least every four years after initial occupancy. The building owner can select to review energy and water use at a more frequent schedule. Further, if the building owner's manual must energy or water use exceed the design baseline by more than 20% on an annualized basis, the owner will further investigate and resolve any issues found or recommend further corrections or modifications to meet the efficiency standards.
			(2) Verification system is installed in the building to monitor post-occupancy energy and water use.	Verification system, such as automated monitoring equipment, is installed that provides a means to measure energy and water usage.
P	P	**1005 INNOVATIVE PRACTICES**		
P	P	**1005.1**	**1005.1 Appraisals.** One or more of the following is implemented:	None.
			(1) Energy rating or projected usage data is posted in an appropriate location in the home, or public posting so that an appraiser can access the energy data for an energy efficiency property valuation.	
			(2) An Appraisal Institute Form 820.05 "Residential Green and Energy Addendum" or Form 821 "Commercial Green and energy Efficient Addendum" that consider NGBS, LEED, ENERGY STAR certifications and equivalent programs, is completed for the appraiser by a qualified professional or builder to use in performing the valuation of the property.	Review Form 820.05 is accurately completed.
P	P		(3) NGBS certification information or one of the Appraisal Institute Forms cited in (2) above is	Review of Form 820.05.
P	P		uploaded to a multiple listing service (MLS) or equivalent database so that appraisers can access it to compare property valuations.	
		CHAPTER 13: COMMERCIAL SPACES NEW CONSTRUCTION		
		13.101.1	**13.101.1 Intent.** This chapter shall provide green requirements for the non-residential portion(s) of a mixed-use building.	
		13.101.2	**13.101.2 Scope.** The provisions of this Chapter shall apply to the design, construction, addition, and alteration of non-residential portion(s) of a mixed-use building.	
		13.102.1	**13.102.1 Compliance.** The non-residential portion(s) of a mixed-use building shall comply with all of the provisions of this chapter as applicable. The provisions of this Chapter are mandatory.	
		13.102.1.1	**13.102.1.1 Core and shell compliance.** The exterior air barrier, insulation, air sealing, and fenestration, are verified to the requirements of this chapter at the time of certification.	For Core & Shell compliance, the following practices must be met: • 13.104.3 • 13.105(1-3) • 13.105.10 (required if ducts are installed) • 13.107.2 • 13.107.6 The following practices are recommended but not required: • 13.105.5 • 13.105.6 See subsequent sections for documentation and inspection requirements
		13.102.1.2	**13.102.1.2 Full mixed-use building compliance.** Residential and non-residential spaces are verified to the requirements of this standard at the time of certification. The residential portions of the building are verified to the requirements of Chapters 5 through 10 of this standard. The non-residential portion(s) of the building must comply with the requirements of this chapter.	
		13.102.1.3	**13.102.1.3 Additions and alterations.** The provisions of this Chapter shall only apply to areas of the building that are exposed or created during the remodel of mixed-use building(s) complying with Section 305, Green Remodeling.	
		13.103.1	**13.103.1 Bicycle parking.** Bicycle parking shall comply with section 103.1.1 through 103.1.2	
		13.103.1.1	**13.103.1.1 Minimum number of spaces.** The minimum number of required bicycle parking spaces shall be 4 parking spaces.	Plan review.
			Exceptions:	
			(1) The number of bicycle parking spaces shall be allowed to be reduced subject to Adopting Entity approval,	
			(2) Bicycle parking shall not be required where the total non-residential conditioned space in the building is less than 1,000 square feet.	
			(3) The minimum number of spaces shall be permitted to be reduced by the authority having jurisdiction based on the occupants expected use of public transit or walking to the building.	
		13.103.1.2	**13.103.1.2 Location.** The bicycle parking must be located on the same building site or within the building. It must be located within 100 ft. of, and visible from the main entrance.	Plan review.
		13.104	**13.104 Resource Efficiency.**	
		13.104.1	**13.104.1 Enhanced Durability.**	
		13.104.1.1	**13.104.1.1 Capillary Break.** A capillary break and vapor retarder shall be installed under the concrete slabs in accordance with ICC IBC Sections 1907, excluding exception #3 and 1805.2.1.	Plans/specifications AND scope of work(s) detailing how requirement has been met. Photo(s) showing installation. Report from certified professional when the building code exceptions are used.
		13.104.1.2	**13.104.1.2 Foundation drainage.** Where required by the ICC IBC for habitable and usable spaces below grade, exterior drain tile is installed.	Plans showing exterior drain tile for foundation, if applicable. Photo(s) showing installation.
		13.104.1.3	**13.104.1.3 Dampproof walls.** Walls that retain earth, and encloses interior space are required to be dampproof per ICC IBC Section 1805.	Plans/specifications showing damp-proofing.
		13.104.1.4	**13.104.1.4 Water-resistive barrier.** Where required by the ICC IBC, a water-resistive barrier	Plans, specification, or scope of work showing WRB or drainage plane.

		and/or drainage plane system is installed behind exterior cladding.	
		Note: Explain N/A	
13.104.1.5		**13.104.1.5 Flashing.** Flashing is provided as follows to minimize water entry into wall and roof assemblies and to direct water to exterior surfaces or exterior water-resistive barriers for drainage. Flashing details are provided in the construction documents and are in accordance with the fenestration manufacturer's instructions, the flashing manufacturer's instructions, or as detailed by a registered design professional. Flashing is installed at the following locations, as applicable unless in conflict with manufacturer's installation instructions:	Plans/construction documents showing flashing details at all required locations.
	(1)	Around exterior fenestrations, skylights, and doors	
	(2)	At roof valleys	
	(3)	At all building-to-deck, -balcony, -porch, and -stair intersections	
	(4)	At roof-to-wall intersections, at roof-to-chimney intersections, at wall-to-chimney intersections, and at parapets	
	(5)	At ends of and under masonry, wood, or metal copings and sills	
	(6)	Above projecting wood trim	
	(7)	At built-in roof gutters, and	
	(8)	Drip edge is installed at eave and rake edges	
	(9)	Window and door head and jamb flashing is either self-adhered or liquid applied	
	(10)	Flashing is installed at exterior windows and doors	
	(11)	Through-wall flashing is installed at transitions between wall cladding materials or wall construction types	
	(12)	Flashing is installed at the expansion joint in stucco walls	
13.104.1.6		**13.104.1.6 Tile backing materials.** Tile backing materials installed under tiled surfaces in wet areas are in accordance with ASTM C1178, C1278, C1288, or C1325. Tile shall not be installed over paper-faced gypsum board in wet areas.	Manufacturer's literature/specification/labeling showing ASTM or other compliance. Plans/specifications and scope of work showing installation.
13.104.1.7		**13.104.1.7 Ice barrier.** In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier is installed in accordance with the ICC IBC at roof eaves of pitched roofs and extends a minimum of 24 inches (610 mm) inside the exterior wall line of the building.	Plans showing ice barrier.
13.104.1.8		**13.104.1.8 Architectural features.** Architectural features that increase the potential for water intrusion are avoided, and must comply with the following:	None.
	(1)	Horizontal ledgers are sloped away to provide gravity drainage as appropriate for the application.	
	(2)	No roof configurations that create horizontal valleys in roof design, unless directed to a drain on a flat roof.	
	(3)	No recessed windows and architectural features that trap water on horizontal surfaces	
13.104.1.9		**13.104.1.9 Moisture control measures.** Moisture control measures for newly installed materials are in accordance with the following:	**REQUIRED FOR CORE & SHELL.** None.
	(1)	Building materials with visible mold are not installed or are cleaned or encapsulated prior to concealment and closing	
	(2)	Insulation in cavities is dry in accordance with manufacturer's installation instructions when enclosed (e.g., with drywall)	
13.104.2		**13.104.2 Construction material and waste management plan.** A written construction waste management plan is posted at the jobsite, and implemented.	Review construction waste management plan.
13.104.3		**13.104.3 Core and shell material selection.** The core and shell of the non-residential portion of the building must contain similar green material selections of the residential portion of the building, and must comply with the additional provisions of this section.	
13.104.3.1		**13.104.3.1 Material selection.** At least six of these sections must be met from the following:	**REQUIRED FOR CORE & SHELL.** See corresponding Chapter 6 practice.
606.1		**606.1 Biobased products.** The following biobased products are used:	
	(a)	certified solid wood in accordance with Section 606.2	
	(b)	engineered wood	
	(c)	bamboo	
	(d)	cotton	
	(e)	cork	
	(f)	straw	
	(g)	natural fiber products made from crops (soy-based, corn-based)	
	(h)	other biobased materials with a minimum of 50 percent biobased content (by weight or volume)	
		Note: Please list "other biobased materials" used in the Notes field	
	(1)	Two types of biobased materials are used, each for more than 0.5 percent of the project's projected building material cost.	
	(2)	Two types of biobased materials are used, each for more than 1 percent of the project's projected building material cost.	
	(3)	For each additional biobased material used for more than 0.5 percent of the project's projected building material cost.	
606.2		**606.2 Wood-based products.** Wood or wood-based products are certified to the requirements of one of the following:	
	(a)	American Forest Foundation's *American Tree Farm System®* (ATFS)	
	(b)	Canadian Standards Association's *Sustainable Forest Management System Standards* (CSA Z809)	
	(c)	*Forest Stewardship Council* (FSC)	
	(d)	*Program for Endorsement of Forest Certification Systems* (PEFC)	
	(e)	*Sustainable Forestry Initiative ® Program (SFI)*	
	(f)	National Wood Flooring Association's Responsible Procurement Program (RPP)	
	(g)	other product programs mutually recognized by PEFC	
	(h)	A manufacturer's fiber procurement system that has been audited by an approved agency as compliant with the provisions of ASTM D7612 as a responsible or certified source. Government or tribal forestlands whose water protection programs have been evaluated by an approved agency as compliant with the responsible source designation of ASTM D7612 are exempt from auditing in the manufacturers' fiber procurement system.	
	(1)	A minimum of two responsible or certified wood-based products are used for minor components of the building.	
		Note: Please list products and components in the Notes fields	
	(2)	A minimum of two responsible or certified wood-based products are used in major components of the building.	
		Note: Please list products and components in the Notes fields	
606.3		**606.3 Manufacturing energy.** Materials manufactured using a minimum of 33 percent of the primary manufacturing process energy derived from (1) renewable sources, (2) combustible waste sources, or (3) renewable energy credits (RECs) are used for major components of the building.	

		(2 points awarded per material.)	
		Note: Please list materials in the Notes field	
608.1		**608.1 Resource-efficient materials.** Products containing fewer materials are used to achieve the same end-use requirements as conventional products, including but not limited to:	
	(1)	lighter, thinner brick with bed depth less than 3 inches and/or brick with coring of more that 25 percent	
	(2)	engineered wood or engineered steel products	
	(3)	roof or floor trusses	
		NOTE: In the assigned Notes area, describe the types of products that comply with 608.1.	
609.1		**609.1 Regional materials.** Regional materials are used for major and/or minor components of the building.	
		For a component to comply with this practice, a minimum of 75% of all products in that component category must be sourced regionally, e.g., stone veneer category – 75 percent or more of the stone veneer on a project must be sourced regionally.	
		NOTE: In the assigned Notes areas, list major and minor materials used that comply with 609.1.	
610.1.2		**610.1.2 Life cycle assessment for a product or assembly.** An environmentally preferable product or assembly is selected for an application based upon the use of an LCA tool that incorporates data methods compliant with ISO 14044 or other recognized standards that compare the environmental impact of products or assemblies.	
610.1.2.1		**610.1.2.1 Product LCA.** A product with improved environmental impact measures compared to another product(s) intended for the same use is selected. The environmental impact measures used in the assessment are selected from the following:	
	(a)	Primary energy use	
	(b)	Global warming potential	
	(c)	Acidification potential	
	(d)	Eutrophication potential	
	(e)	Ozone depletion potential	
	(f)	Smog potential	
		(Points are awarded for each product/system comparison where the selected product/system improved upon the environmental impact measures by an average of 15 percent.)	
		NOTE: List products/systems compared & impact measures considered in the assigned Notes area.	
610.1.2.2		**610.1.2.2 Building assembly LCA.** A building assembly with improved environmental impact measures compared to an alternative assembly of the same function is selected. The full life cycle, from resource extraction to demolition and disposal (including but not limited to on-site construction, maintenance and replacement, material and product embodied acquisition, and process and transportation energy), is assessed. The assessment includes all structural elements, insulation, and wall coverings of the assembly. The assessment does not include electrical and mechanical equipment and controls, plumbing products, fire detection and alarm systems, elevators, and conveying systems. The following types of building assemblies are eligible for points under this practice:	
	(a)	exterior walls	
	(b)	roof/ceiling	
	(c)	interior walls or ceilings	
	(d)	intermediate floors	
		The environmental impact measures used in the assessment are selected from the following:	
	(a)	Primary energy use	
	(b)	Global warming potential	
	(c)	Acidification potential	
	(d)	Eutrophication potential	
	(e)	Ozone depletion potential	
	(f)	Smog potential	
		(Points are awarded based on the number of types of building assemblies that improve upon environmental impact measures by an average of 15 percent.)	
		NOTE: List assemblies compared & impact measures considered in the assigned Notes area.	
612.1		**612.1 Manufacturer's environmental management system concepts.** Product manufacturer's operations and business practices include environmental management system concepts, and the production facility is registered to ISO 14001 or equivalent. The aggregate value of building products from registered ISO 14001 or equivalent production facilities is 1 percent or more of the estimated total building materials cost.	
		(1 point awarded per percent.)	
		NOTE: In the assigned Notes area, list products that comply with 610.1, manufacturers, and ISO registrars.	
612.2		**612.2 Sustainable products.** One or more of the following products are used for at least 30% of the floor or wall area of the entire dwelling unit or the sleeping unit, as applicable. Products are certified by a third-party agency accredited to ISO 17065.	
	(1)	50% or more of carpet installed (by square feet) is certified to NSF 140 or equivalent.	
	(2)	50% or more of resilient flooring installed (by square feet) is certified to NSF 332 or equivalent.	
	(3)	50% or more of the insulation installed (by square feet) is certified to UL 2985 or equivalent.	
	(4)	50% or more of interior wall coverings installed (by square feet) is certified to NSF 342 or equivalent.	
	(5)	50% or more of the gypsum board installed (by square feet) is certified to UL 100 or equivalent.	
	(6)	50% or more of the door leafs installed (by number of door leafs) is certified to UL 102 or equivalent.	
	(7)	50% or more of the tile installed (by square feet) is certified to TCNA A138.1 Specifications for Sustainable Ceramic Tiles, Glass Tiles and Tile Installation Materials or equivalent.	
603.2		**603.2 Salvaged materials.** Reclaimed and/or salvaged materials and components are used. The total material value and labor cost of salvaged materials is equal to or exceeds 1 percent of the total construction cost.	
		(Points awarded per 1% of salvaged materials used based on the total construction cost.)	
		NOTE: Describe materials used in the assigned Notes area. Materials, elements, or components awarded points under Section 603.1 shall not be awarded points under Section 603.2.	

611.1	**611.1 Product declarations.** A minimum of 10 different products installed in the building project, at the time of certificate of occupancy, comply with one of the following sub-sections. Declarations, reports, and assessments are submitted and contain documentation of the critical peer review by an independent third party, results from the review, the reviewer's name, company name, contact information, and date of the review.	
611.1.1	**611.1.1 Industry-wide declaration.** A Type III industry-wide environmental product declaration (EPD) is submitted for each product. Where the program operator explicitly recognizes the EPD as representative of the product group on a National level, it is considered industry-wide. In the case where an industry-wide EPD represents only a subset of an industry group, as opposed to being industry-wide, the manufacturer is required be explicitly recognized as a participant by the EPD program operator. All EPDs are required to be consistent with ISO Standards 14025 and 21930 with at least a cradle-to-gate scope. **(Each product complying with Section 611.1.1 shall be counted as one product for compliance with Section 611.1.)**	
	NOTE: List products in the assigned Notes area.	
611.1.2	**611.1.2 Product Specific Declaration.** A product specific Type III EPD are submitted for each product. The product specific declaration shall be manufacturer specific for an individual product or product family. All Type III EPDs are required to be certified as complying, at a minimum, with the goal and scope for the cradle-to-gate requirements in accordance with ISO Standards 14025 and 21930. **(Each product complying with Section 611.1.2 shall be counted as two products for compliance with Section 611.1.)**	
	NOTE: List products in the assigned Notes area.	
604.1	**604.1 Recycled content.** Building materials with recycled content are used for two minor and/or two major components of the building.	
	Enter material percent recycled content.	
	See Table 604.1	
	NOTE: In the assigned Notes area, list materials used for minor and/or major building components.	
13.104.4	**13.104.4 Recycling and composting.** A readily accessible space(s) adequate to accommodate the recycling and composting containers for materials accepted in local recycling/composting programs is provided and identified on the floorplan.	Plan review.
13.105	**13.105 Energy Efficiency.**	
13.105.1	**13.105.1 Building thermal envelope insulation.** The non-residential portion of the building must comply with the insulation requirements of Sections C402.1 through C402.3 of the ICC IECC as applicable, and Section 105.1.1. A UA tradeoff shall be allowed for sections 105.1 and 105.2 is equal to or less than the IECC UA.	**REQUIRED FOR CORE & SHELL.** COMcheck analysis.
	Maximum UA. For IECC residential, the total building UA is less than or equal to the total maximum UA as computed by 2015 IECC Section R02.1.5. For IECC commercial, the total UA is less than or equal to the sum of the UA for 2015 IECC Tables C402.1.4 and C402.4, including the U-factor times the area and C-factor or F-factor times the perimeter. The total UA proposed and baseline calculations are documented. REScheck or COMcheck is deemed to provide UA calculation documentation.	REScheck or COMcheck output, for either full building or commercial space.
13.105.1.1	**13.105.1.1 Insulation installation.** Insulation installed in the thermal envelope shall be visually inspected for compliance with Grade I installation. Grade II insulation is only permitted where exterior continuous insulation is installed. Grade III insulation installation is not permitted.	**REQUIRED FOR CORE & SHELL.** None.
13.105.2	**13.105.2 Building thermal envelope fenestration.** The non-residential portion of the building shall be in accordance with the requirements of Section C402.4 of the International Energy Conservation Code as applicable.	**REQUIRED FOR CORE & SHELL.** COMcheck or other equivalent analysis method demonstrating compliance.
	Section C402.4 of the IECC	
13.105.3	**13.105.3 Building thermal envelope air sealing.** The building thermal envelope is durably sealed to limit infiltration. The sealing methods between dissimilar materials allow for differential expansion and contraction. The following are caulked, gasketed, weather-stripped or otherwise sealed with an air barrier material, suitable film, or solid material:	**REQUIRED FOR CORE & SHELL.** Drawing, specifications, scopes of work detailing air sealing that is not readily inspected during the rough inspection.
(1)	All joints, seams and penetrations	
(2)	Site-built windows, doors and skylights	
(3)	Openings between window and door assemblies and their respective jambs and framing	
(4)	Utility penetrations	
(5)	Dropped ceilings or chases adjacent to the thermal envelope	
(6)	Knee walls	
(7)	Walls and ceilings separating the garage from conditioned spaces	
(8)	Behind tubs and showers on exterior walls	
(9)	Cantilevers	
(10)	Attic access openings	
(11)	Rim joists junction	
(12)	Other sources of infiltration	
13.105.3.1	**13.105.3.1 Air barrier verification.** If not previously verified, the air barrier shall be visually inspected to demonstrate compliance with Table 701.4.3.2(2) and shall comply with the requirements of IECC C402.5.	**REQUIRED FOR CORE & SHELL.** None.
13.105.4	**13.105.4 Energy metering.** Energy metering shall be provided for each tenant individually for the non-residential portions of the building. **Exception:** non-residential spaces under 10,000 square feet.	Plan review.
13.105.5	**13.105.5 Efficiency of HVAC equipment.** HVAC equipment shall meet the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) of the International Energy Conservation Code.	Plan review and manufacturer's literature.
	NOTE: For Code & Shell projects, practice is recommended but not required.	
13.105.6	**13.105.6 Efficiency of Service Water Heating equipment.** Service Water Heating equipment shall meet the minimum efficiency requirements listed in ICC IECC Table C404.2.	Plan review.
	NOTE: For Code & Shell projects, practice is recommended but not required.	
13.105.7	**13.105.7 Lighting.** The total interior lighting power allowance shall be less than the total lighting power allowance in accordance with Section C405.3.2 of the International Energy Conservation Code.	Plan review.
13.105.8	**13.105.8 Commissioning.**	
13.105.8.1	**13.105.8.1 Mechanical and service water heating systems.** Mechanical and service water heating systems shall comply with ICC IECC Section C408.2.	Plan review.
13.105.9	**13.105.9 Calculation of heating and cooling loads.** Design loads associated with heating, ventilating and air conditioning of the building shall be determined in accordance with	Software output report for this building.

		ANSI/ASHRAE/ACCA Standard 183 or by an approved equivalent computational procedure and using the design parameters specified in Chapter 3 of the ICC IECC. Heating and cooling loads shall be adjusted to account for load reductions that are achieved where energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE HVAC Systems and Equipment Handbook or an approved equivalent computational procedure.	
13.105.10		**13.105.10 Duct air sealing.** Ductwork shall be constructed in accordance with the ICC IMC.	**REQUIRED FOR CORE & SHELL.** Plan review.
		NOTE: For Core & Shell projects, practice is required if ducts are installed.	
13.105.11		**13.105.11 Heated-water circulation and temperature maintenance.** Where installed, heated-water circulation systems shall be in accordance with Section 105.11.1. Heat trace temperature maintenance systems shall be in accordance with Section 105.11.2. Controls for hot water storage shall be in accordance with Section 105.11.3. Automatic controls, temperature sensors, and pumps shall be in a location that is accessible. Manual controls shall be in a location with ready access.	
13.105.11.1		**13.105.11.1 Circulation systems.** Heated-water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe, or a cold water supply pipe. Gravity and thermos-syphon circulation systems shall be prohibited. Controls for circulation hot water system pumps shall start the pump based on the identification of a demand for hot water. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is not a demand for hot water.	Plan review.
13.105.11.2		**13.105.11.2 Heat trace systems.** Electric heat trace systems shall comply with IECC 505.1. Controls for such systems shall be able to automatically adjust the energy input to the heat tracing to maintain the desired water temperature in the piping in accordance with the times when heated water is used in the occupancy. Heat trace shall be arranged to be turned off automatically when there is not a demand for hot water.	Plan review.
13.105.11.3		**13.105.11.3 Controls for hot water storage.** The controls on pumps that circulate water between a water heater and a heated water storage tank shall limit the operation of the pump from the heating cycle startup to not greater than 5 minutes are the end of the cycle.	Plan review.
13.105.12		**13.105.12 Energy options.** Non-residential portions of the building shall comply with one of the three options below:	
13.105.12.1		**13.105.12.1.** Energy requirements shall be met if modeling in accordance with C407 shows a 10% reduction in energy from the IECC.	Energy performance report showing energy savings levels above ICC IECC. See Energy Efficiency Modeling Policy in VRG Part I for details on eligible software and accepted approaches. This can be submitted as an Excel table or another file format. The 2018 IECC must be the basis for this analysis.
13.105.12.2		**13.105.12.2.** Energy requirements shall be met if modeling in accordance with ASHRAE 90.1 Appendix G shows a 10% reduction in energy cost from the prescribed levels.	Energy performance report showing energy savings levels.
13.105.12.3		**13.105.12.3.** Energy requirements shall be met if at least two options in IECC Section C406 are met.	Plan review.
		NOTE: List which options from C406 that were met in the assigned Notes field.	
13.106		**13.106 Water efficiency and conservation.**	
13.106.1		**13.106.1 Fitting and fixture consumption.** Plumbing fixtures and fixture fittings shall comply with the maximum flow rates specified in Table 106.1. Plumbing fixtures and fixture fittings in Table 106.1 shall have a manufacturer's designation for flow rate. **Exceptions:** The following fixtures and devices shall not be required to comply with the reduced flow rates in Table 106.1.	Review of manufacturer's literature for fixtures.
	(1)	Clinical sinks having a maximum water consumption of 4.5 gallons (17 L) per flush.	
	(2)	Service sinks faucets, tub fillers, pot fillers, laboratory faucets, utility faucets, and other fittings designed primarily for filling operations.	
	(3)	Fixtures, fittings, and devices whose primary purpose is safety.	
13.106.2		**13.106.2 Once-through cooling for appliances and equipment.** Once-through or single-pass cooling with potable or municipal reclaimed water is prohibited.	Plan review.
13.106.3		**13.106.3 Clothes washers.** Clothes washers rated with an IWF (integrated water factor), MEF (modified energy factor), or IMEF (integrated modified energy factor), shall be rated as follows:	Review of manufacturer's literature.
	(1)	Residential Clothes Washers, Front-loading, > 2.5 cu-ft maximum IWF 3.2 minimum IMEF 2.76	
	(2)	Residential Clothes Washers, T op-loading, > 2.5 cu-ft maximum 4.3 IWF, minimum IMEF 2.06	
	(3)	Residential Clothes Washers (≤ 2.5 cu-ft) maximum 4.2 IWF, minimum IMEF 2.07	
	(4)	Commercial Clothes Washers maximum 4.0 IWF, minimum MEF 2.20	
13.106.4		**13.106.4 Food Service.**	
13.106.4.1		**13.106.4.1 Dipper wells.** The water supply to a dipper well shall have a shutoff valve and flow control valve. The maximum flow shall not exceed 1 gpm (3.78 lpm) at a supply pressure of 60 psi (413.7 kPa). The dipper well shall have a manufacturer's designation of flow rate.	Review of manufacturer's literature.
13.106.4.2		**13.106.4.2 Food waste disposal.** The disposal of food wastes that are collected as part of preparing ware for one or more of the following shall accomplish washing:	Review of manufacturer's literature.
	(1)	A food strainer (scrapper) basket that is emptied into a trash can.	
	(2)	A garbage grinder where the water flow into the food waste disposer is controlled by a load sensing device such that the water flow does not exceed 1 gpm under no-load operating conditions and 8 gpm under full-load operating conditions.	
	(3)	A pulper or mechanical strainer that uses not more than 2 gpm of potable water.	
13.106.4.3		**13.106.4.3 Pre-rinse spray heads.** Food service pre-rinse spray heads shall have a manufacturers designation of flow rate, shall comply with the maximum flow rate in Table 1305.1, and shall shut off *automatically* when released.	Review of manufacturer's literature.
13.106.4.4		**13.106.4.4 Hand washing faucets.** Faucets for hand washing sinks in food service preparation and serving areas shall be of the self-closing type.	None.
13.106.5		**13.106.5. Water softeners.** Water softeners shall comply with Sections 13.106.5.1 through 13.106.5.3.	
13.106.5.1		**13.106.5.1 Demand initiated regeneration.** Water softeners shall be equipped with demand-initiated regeneration control systems. Such control systems shall automatically initiate the regeneration cycle after determining the depletion, or impending depletion of softening capacity.	Review of manufacturer's literature.
13.106.5.2		**13.106.5.2 Water consumption.** Water softeners shall have a maximum water consumption during regeneration of 5 gal (18.9 L) per 1000 grains of hardness removed as measured in accordance with NSF 44.	Review of manufacturer's literature.
13.106.5.3		**13.106.5.3 Waste connections.** Waste water from water softener regeneration shall not discharge to reclaimed, gray water or rainwater water collection systems and shall discharge in	Plan review.

		accordance with the *International Plumbing Code* .	
13.106.6		**13.106.6 Heat exchangers.** Once-through or single-pass cooling with potable or municipal reclaimed water is prohibited. Heat exchangers shall be connected to a recirculating water system such as a chilled water loop, cooling tower loop, or similar recirculating system.	Plan review.
13.107		**13.107 Indoor Air Quality.**	
13.107.1		**13.107.1 Carpets.** Carpeting is not installed adjacent to water closets and bathing and or shower fixtures.	None.
13.107.1.1		**13.107.1.1 Entry.** The primary entryway from the outdoors shall include one of the following:	(1) None or (2) review contract.
	(1)	Permanent walk-off mat that allows access for cleaning (e.g., grating with catch basin); or	
	(2)	Roll-out mat that will be maintained on a weekly basis by a contracted service.	
13.107.2		**13.107.2 Prohibited materials.** The use of the following materials shall be prohibited:	**REQUIRED FOR CORE & SHELL.** Plan review.
	(1)	Asbestos-containing materials	
	(2)	Urea-formaldehyde foam insulation	
13.107.3		**13.107.3 Product emissions.** At least five types of the following product categories must meet their respective section of the Standard referenced below:	Refer to the Chapter 9 requirements for the relevant practice.
901.4		**901.4** Wood materials. A minimum of 85 percent of material within a product group (i.e., wood structural panels, countertops, composite trim/doors, custom woodwork, and/or component closet shelving) is manufactured in accordance with the following:	
	(1)	Structural plywood used for floor, wall, and/or roof sheathing is compliant with DOC PS 1 and/or DOC PS 2. OSB used for floor, wall, and/or roof sheathing is compliant with DOC PS 2. The panels are made with moisture-resistant adhesives. The trademark indicates these adhesives as follows: Exposure 1 or Exterior for plywood, and Exposure 1 for OSB.	
		NOTE: If "N/A" is selected, please explain in the Notes area.	
		Countertops	
		Composite trim/doors	
		Custom woodwork	
		Component closet shelving	
	(2)	Particleboard and MDF (medium density fiberboard) is manufactured and labeled in accordance with CPA A208.1 and CPA A208.2, respectively.	
	(3)	Hardwood plywood in accordance with HPVA HP-1.	
	(4)	Particleboard, MDF, or hardwood plywood is in accordance with CPA 4.	
	(5)	Composite wood or agrifiber panel products contain no added urea-formaldehyde or are in accordance with the CARB *Composite Wood Air Toxic Contaminant Measure Standard* .	
	(6)	Non-emitting products.	
901.5		**901.5 Cabinets.** A minimum of 85 percent of installed cabinets are in accordance with one or both of the following:	
		(Where both of the following practices are used, only 3 points are awarded.)	
	(1)	All parts of the cabinet are made of solid wood or non-formaldehyde emitting materials such as metal or glass.	
	(2)	The composite wood used in wood cabinets is in accordance with CARB *Composite Wood Air Toxic Contaminant Measure Standard* or equivalent as certified by a third-party program such as, but not limited to, those in Appendix D.	
901.7		**901.7 Floor materials.** The following types of finished flooring materials are used. The materials have emission levels in accordance with CDPH/EHLB Standard Method v1.1. Product is tested by a laboratory with the CDPH/EHLB Standard Method v1.1 within the laboratory scope of accreditation to ISO/IEC 17025 and certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix D.	
		(Points are awarded for every 10% of conditioned floor space using one of the below materials.)	
	(1)	Hard surface flooring: Prefinished installed hard-surface flooring is installed. Where post-manufacture coatings or surface applications have not been applied, the following hard surface flooring types are deemed to comply with the emission requirements of this practice:	
	(a)	Ceramic tile flooring	
	(b)	Organic-free, mineral-based flooring	
	(c)	Clay masonry flooring	
	(d)	Concrete masonry flooring	
	(e)	Concrete flooring	
	(f)	Metal flooring	
	(2)	Carpet meeting and carpet cushion not meeting the emission limits is installed.	
	(3)	Carpet and carpet cushion meeting the emission limits is installed.	
		(When carpet cushion meeting the emission limits of the practice is also installed, the percentage of compliant carpet area is calculated at 1.33 times the actual installed area.)	
901.8		**901.8 Wall coverings.** A minimum of 10 percent of the interior wall surfaces are covered and a minimum of 85 percent of wall coverings are in accordance with the emission concentration limits of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix D.	
901.9		**901.9 Interior architectural coatings.** A minimum of 85 percent of the interior architectural coatings are in accordance with either Section 901.9.1 or Section 901.9.3, not both. A minimum of 85 percent of architectural colorants are in accordance with Section 901.9.2.	
901.9.1		**901.9.1** Site-applied interior architectural coatings, which are inside the water proofing envelope, are in accordance with one or more of the following:	
	(1)	Zero VOC as determined by EPA Method 24 (VOC content is below the detection limit for the method)	
	(2)	GreenSeal GS-11	
	(3)	CARB *Suggested Control Measure for Architectural Coatings* (see Table 901.9.1). See Table 901.9.1	
901.9.2		**901.9.2** Architectural coating colorant additive VOC content is in accordance with Table 901.9.2.	
		(Points for 901.9.2 are awarded only if base architectural coating is in accordance with 901.9.1.)	
		See Table 901.9.2	
901.9.3		**901.9.3** Site-applied interior architectural coatings, which are inside the waterproofing envelope, are in accordance with the emission levels of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 in its scope of accreditation. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those found in Appendix D.	

		accredited to ISO 17065, such as, but not limited to, those found in Appendix D.	
901.10		**901.10 Interior adhesives and sealants.** A minimum of 85 percent of site-applied adhesives and sealants located inside the waterproofing envelope are in accordance with one of the following, as applicable.	
	(1)	The emission levels are in accordance with CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those found in Appendix D.	
	(2)	GreenSeal GS-36.	
	(3)	SCAQMD Rule 1168 in accordance with Table 901.10(3), excluding products that are sold in 16 ounce containers or less and are regulated by the California Air Resources Board (CARB) Consumer Products Regulations.	
		See Table 901.10(3)	
901.11		**901.11 Insulation.** Emissions of 85 percent of wall, ceiling, and floor insulation materials are in accordance with the emission levels of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation. Insulation is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix D.	
13.107.4		**13.107.4 Fireplaces and appliances.** Where located within buildings, fireplaces, solid fuel-burning appliances, vented decorative gas appliances, vented gas fireplace heaters and decorative gas appliances for installation in fireplaces shall comply with Sections 107.4.1 through 107.4.5.	
13.107.4.1		**13.107.4.1 Venting and combustion air.** Fireplaces and fuel-burning appliances shall be vented to the outdoors and shall be provided with combustion air provided from the outdoors in accordance with the International Mechanical Code and the International Fuel Gas Code. Solid-fuel-burning fireplaces shall be provided with a means to tightly close off the chimney flue and combustion air openings when the fireplace is not in use.	None.
13.107.4.2		**13.107.4.2 Wood-fired appliances.** Wood stoves and wood-burning fireplace inserts shall be listed and, additionally, shall be labeled in accordance with the applicable requirement.	Review of manufacturer's literature.
	(1)	Site-built masonry wood-burning fireplaces use outside combustion air and include a means of sealing the flue and the combustion air outlets to minimize interior air (heat) loss when not in operation.	
	(2)	Factory-built, wood-burning fireplaces are in accordance with the certification requirements of UL 127.	
	(3)	Wood stove and fireplace inserts, as defined in UL 1482 Section 3.8, are in accordance with the certification requirements of UL 1482.	
13.107.4.3		**13.107.4.3 Biomass appliances.** Biomass fireplaces, stoves and inserts shall be listed and labeled in accordance with ASTM E 1509 or UL 1482. Biomass furnaces shall be listed and labeled in accordance with CSA B366.1 or UL 391. Biomass boilers shall be listed and labeled in accordance with CSA B366.1 or UL 2523.	Review of manufacturer's literature.
13.107.4.4		**13.107.4.4 Gas-fireplaces.** Gas-fired fireplaces and direct heating equipment is listed and is installed in accordance with the NFPA 54, ICC IFGC, or the applicable local gas appliance installation code. Gas-fired fireplaces within dwelling units and direct heating equipment are vented to the outdoors.	Review of manufacturer's literature.
13.107.4.5		**13.107.4.5 Unvented.** Unvented room heaters and unvented decorative appliances, including alcohol burning, shall be prohibited.	None.
13.107.5		**13.107.5 Protection of HVAC system openings.** HVAC supply and return duct and equipment openings shall be protected during dust-producing operations of construction.	Plan review.
13.107.6		**13.107.6 Garages.** Attached garages are in accordance with the following:	None.
	(1)	Doors installed in the common wall between the attached garage and conditioned space are tightly sealed and gasketed.	
	(2)	A continuous air barrier is provided separating the garage space from the conditioned spaces.	
13.107.7		**13.107.7 Spot Ventilation.** Exhaust systems shall be provided in accordance with Chapter 5 of the ICC IMC or ASHRAE 62.1.	Plan review.
13.107.8		**13.107.8 Building Ventilation Systems.**	
13.107.8.1		**13.107.8.1 Building Ventilation.** Ventilation shall be provided to non-residential spaces in accordance with Chapter 4 of the ICC IMC or ASHRAE 62.1.	Plan review.
13.107.8.2		**13.107.8.2 Air filters.** Air filters with a minimum MERV rating of 6 are installed on central forced air systems and are accessible.	Plan review.
13.107.9		**13.107.9 Radon system.** Commercial spaces in building located in Zone 1 shall comply with section 902.3.	
902.3		**902.3 Radon reduction measures.** Radon reduction measures are in accordance with ICC IRC Appendix F or 902.3.1. Radon Zones as identified by the AHJ or, if the zone is not identified by the AHJ, as defined in Figure 9(1).	Refer to 902.3 for instructions and guidance. Also see Multifamily Radon Testing Policy.
	(1)	Buildings located in Zone 1	
	(a)	a passive radon system is installed	
	(b)	an active radon system is installed	
902.3.1		**902.3.1 Radon reduction option.** This option requires section 902.3.1.1 through 902.3.1.7.	
902.3.1.1		**902.3.1.1 Soil-gas barriers and base course.** A base course in accordance with Section 506.2.2 of the IRC shall be installed below slabs and foundations. There shall be a continuous gas-permeable base course under each soil-gas retarder that is separated by foundation walls or footings. Between slabs and the base course, damp proofing or water proofing shall be installed in accordance with Section 406 of the IRC. Punctures, tears and gaps around penetrations of the soil-gas retarder shall be repaired or covered with an additional soil-gas retarder. The soil-gas retarder shall be a continuous6-mil (0.15 mm) polyethylene or an approved equivalent.	
902.3.1.2		**902.3.1.2 Soil gas collection.** There shall be an unobstructed path for soil gas flow between the void space installed in the base course and the vent through the roof. Soil gases below the foundation shall be collected by a perforated pipe with a diameter of not less than 4 inches (10 cm) and not less than 5 feet (1.5 m) in total length. A tee fitting or equivalent method shall provide two horizontal openings to the radon collection. The tee fitting shall be designed to prevent clogging of the radon collection path. Alternately the soil gas collection shall be by approved radon collection mats or an equivalent approved method.	
902.3.1.3		**902.3.1.3 Soil gas entry routes.** Openings in slabs, soil-gas retarders, and joints such as, but not limited to, plumbing, ground water control systems, soil-gas vent pipes, piping and structural supports, shall be sealed against air leakage at the penetrations. The sealant shall be a	

		polyurethane caulk, expanding foam or other approved method. Foundation walls shall comply with Section 103.2.3 of the IRC. Sumps shall be sealed in accordance with Section 103.2.2 of the IRC. Sump pits and sump lids intended for ground water control shall not be connected to the sub-slab soil-gas exhaust system.	
902.3.1.4		**902.3.1.4 Soil gas vent.** A gas-tight pipe vent shall extend from the soil gas permeable layer though the roof. The vent pipe size shall not be reduced at any location as it goes from gas collection to the roof. Exposed and visible interior vent pipes shall be identified with not less than one label reading "Radon Reduction System" on each floor and in habitable attics.	
902.3.1.5		**902.3.1.5 Vent pipe diameter.** The minimum vent pipe diameter shall be as specified in Table 902.3.2.5.	
902.3.1.6		**902.3.1.6 Multiple vented areas.** In dwellings where interior footings or other barriers separate the soil-gas permeable layer, each area shall be fitted with an individual vent pipe. Vent pipes shall connect to a single vent that terminates above the roof or each individual vent pipe shall terminate separately above the roof.	
902.3.1.7		**902.3.1.7 Fan.** Each sub-slab soil-gas exhaust system shall include a fan, or dedicated space for the post-construction installation of a fan. The electrical supply for the fan shall be located within 6 feet (1.8 m) of the fan. Fan is not required to be on a dedicated circuit.	
902.3.2		**902.3.2 Radon testing.** Radon testing is mandatory for Zone 1.	
		Exceptions:	
		(2) Testing is not mandatory where the occupied space is located above an unenclosed open space.	
	(1)	Testing specifications. Testing is performance as specified in (a) through (j).	
	(a)	Testing is performed after the residence passes its airtightness test.	
	(b)	Testing is performed after the radon control system installation is complete. If the system has an active fan, the residence shall be tested with the fan operating.	
	(c)	Testing is performed at the lowest level within a dwelling unit which will be occupied, even if the space is not finished.	
	(d)	Testing is not performed in a closet, hallway, stairway, laundry room, furnace room, kitchen or bathroom.	
	(e)	Testing is performed with a commercially available test kit or with a continuous radon monitor that can be calibrated. Testing shall be in accordance with the testing device manufacturer's instructions.	
	(f)	Testing shall be performed by the builder, a registered design professional, or an approved third party.	
	(g)	Testing shall extend at least 48 hours or to the minimum specified by the manufacturer, which ever is longer.	
	(h)	Written radon test results shall be provided by the test lab or testing party. Written test results shall be included with construction documents.	
	(i)	An additional pre-paid test kit shall be provided for the homeowner to use when they choose. The test kit shall include mailing or emailing the results from the testing lab to the homeowner.	
	(j)	Where the radon test result is 4 pCi/L or greater, the fan for the radon vent pipe shall be installed.	
13.108		**13.108 Operation, Maintenance, and Building Owner Education.**	
13.108.1		**13.108.1 OPERATION AND MAINTENANCE MANUALS FOR TENANTS.** Manuals are provided to the initial tenants of the non-residential space regarding the operation, and maintenance of the building. Paper or digital format manuals are to include information regarding those aspects of the building's maintenance, and operation that are within the area of responsibilities of the respective tenant. One or more responsible parties are to receive a copy of all documentation for archival purposes.	
	(1)	A narrative detailing the importance of operating in a green building. This narrative is included in all responsible parties' manuals.	
	(2)	A list of practices to conserve water and energy which require maintenance.	
	(3)	Information on opportunities to purchase renewable energy from local utilities or national green power providers.	
	(4)	Information on local and on-site recycling and hazardous waste disposal programs.	
	(5)	Local public transportation options for employees.	
13.108.2		**13.108.2 TENANT FINISH-OUT MANUAL.** Manuals are provided to the tenants of the non-residential space prior to the start of construction regarding the design and construction of the non-residential portion of the building. Paper or digital format manuals are to include information regarding those aspects of the design and construction that are within the area of responsibilities of the respective tenant. One or more responsible parties are to receive a copy of all documentation for archival purposes.	Review manual to make sure it is compliant with sub-practices.
	(1)	Provisions of this Chapter verified at the time of building Certification for the respective space that shall be maintained as part of the Tenant Finish Out	
	(2)	Provisions of this Chapter NOT verified at the time of building Certification for the respective space that shall be included in the Tenant Finish Out Construction Documents.	
	(3)	A list of minimum green building material specifications that are to be included in the Tenant Finish Out Construction Documents based on the materials that were installed in the residential portion of the building.	

Summary of Results of the Design Phase

Scoring Tool Version: 5.2.20 **Revision Date:** 2/28/2024

Project Name: Douglas Station

Location: Nw Sloan & NE Sycamore, Lees Summit, Missouri 64064

✓	No Mandatory items missing on the "Overview (Design)" page

	Points Required				Points Claimed	Mandatory Practices	No Errors
	Bronze	Silver	Gold	Emerald			
Chapter 5: Lot Design, Preparation, and Development	50	64	93	121	**84**	✓	✓
Chapter 6: Resource Efficiency	43	59	89	119	**84**	✓	✓
Chapter 7: Energy Efficiency	30	45	60	70	**67**	✓	✓
Chapter 8: Water Efficiency	25	39	67	92	**57**	✓	✓
Chapter 9: Indoor Environmental Quality	25	42	69	97	**56**	✓	✓
Chapter 10: Operation, Maintenance, and Building Owner Education	8	10	11	12	**18**	✓	✓
Additional Points required	50	75	100	100			
Additional points required due to SF over 4000 (601.1)	0	0	0	0			
Total points required	231	334	489	611	**366**		
Additional Points Claimed	**185**	**107**	**(23)**	**(145)**			

Overall Level Achieved for Design	**Silver**

Net Zero Energy: See Section Header
Resilience: Not Earned
Smart Home: Not Earned
Universal Design: Not Earned
Wellness: Not Earned
Zero Water: Not Earned

NGBS GREEN
Home Innovation Research Labs

Version 1.2 / Revised September 2021

Home Address: Nw Sloan & NE Sycamore, Lees Summit, Missouri 64064
Community/Lot #: Douglas Station

Notes:

Net Zero Energy

Not Expected to Meet Based on Expected Energy Performance from Selected Path – However, Badge Compliance is Based on Separate Energy Analysis Documentation that is Independent from This Tool, and Badge is Available for All Energy Compliance Paths.

Building Envelope

Roof R-Value:	
Floor R-Value:	
Wall R-Value:	
Describe Wall Section:	

Window-Wall Ratio:	
Window U-Value:	
Window SHGC:	
Window Description:	

Exterior Shading Devices:	
Air Leakage Test Results:	
Air Sealing Protocol Description:	

Lighting

Type of Lighting Description:	
Daylighting Features Description:	
Occupancy Sensors Description:	
Describe Lighting Design & Control Strategy:	

HVAC System Characteristics (Check all included technologies and note efficiency values)

☐ Gas and Propane Heater	
☐ Oil Furnace	
☐ Gas Boiler	
☐ Oil Boiler	
☐ Radiant and Hydronic Space Heating	
☐ Electric Heat Pump	
☐ Gas Engine-Driven Heat Pump Heating	
☐ Electric Air Conditioner and Heat Pump Cooling	
☐ Gas Engine-Driven Heat Pump Cooling	
☐ Water Source Cooling and Heating	
☐ Ground Source Heat Pump	
Describe Mechanical System:	

Ventilation

☐ Spot Ventilation Only:	
☐ Building Ventilation Systems:	

Energy Storage

Battery Storage Description:	

Renewable Energy System Characteristics

Describe systems here. Submit photos of installed on-site systems and appropriate documentation (e.g., solar installer design report, power purchase agreement, or renewable energy credit certificate) of installed system.

Projected energy usage:	
Projected renewable energy delivered:	
Solar electric (PV): array size and output per capacity nameplate, panel quantity, type and brand, inverter quantity, type and location(s).	
Solar Thermal	
Collector Area (ft^2):	
Collector Slope(degrees):	
Efficiency(%):	
Tank Volume (gallons):	
Maximum Heating Rate (Btu/hr):	
Wind: (If onsite: note turbine size and output in peak kw, inverter type, brand and location. If off-site, note farm location, overall size, and purchased share of energy expected.)	
Have Renewable Energy Credits been retained? If yes, describe amount (KWh) and plan for recurring purchase, if any.	
Geothermal	
Maximum Power (hp):	
Surface Temperature of Fluid (F):	
Estimated Reservoir Temperature at 6,500 Feet (F):	
Area of Geothermal Field (mi^2):	
Number of Wells Drilled:	
Efficiency (%):	

Resilience

Not Earned

SECTION 1: ENHANCED RESILIENCE

Requirements:

Meet one of the below practices.

Practices

613.5 Enhanced resilience - 30% above base design 613.6 Enhanced resilience - 40% above base design 613.7 Enhanced resilience - 50% above base design	**Not Met**

SECTION 2: RENEWABLE ENERGY AND BATTERY ENERGY STORAGE SYSTEMS

Requirements:

Meet mandatory practice.

Practices

706.5(3) On-site renewable energy system and battery energy storage system	**Not Met**

Additional Requirements
Identify resilient construction features and benefits are described in homeowner or multifamily occupant manual.

☐

Smart Home

Not Earned

SECTION 1: LIGHTING & LIGHTING CONTROLS /WINDOW SHADING

Requirements:

Meet applicable mandatory practice.

Select optional practices to contribute toward meeting overall point total (18 required).

Practices	Points Available	
612.3(9) Automated or voice-activated control of HVAC, lighting, alarm system or door locks	Mandatory	**Not Met**
703.7.2 Automated Solar Protection	1	☐
705.2.1.1(1 or 2) Interior Lighting Controls	1-2	**0**
705.2.1.2 Exterior Lighting Controls	1	**1**
705.2.3 Lighting Outlets	1	**0**
705.2.1.3(1-2) Multifamily Common Areas	1-5 (MF Only)	**0**
705.2.1.4(1-2) Multifamily Occupancy Controls	2-3 (MF Only)	**0**

SECTION 2: ENERGY & WATER CONSUMPTION CONTROL

Requirements

Meet applicable mandatory practice.

Select optional practices to contribute toward meeting overall point total (18 required).

Practices	Points Available	
706.1(1) Remote, Programmable Thermostat	Mandatory	**Not Met**
706.10 Automatic Demand Response	1	**0**
706.11 Grid-Interactive Battery Storage	2	**0**
1004.1(2) Verification System for Post-Occupancy Monitoring	3	**0**
706.1(2-5) Energy Consumption Control	2	**0**
706.3 Smart Appliances and Systems	1-2	**0**

SECTION 3: SMART CONTROLS FOR WATER EFFICIENCY

Requirements:

Meet applicable mandatory practice.

Select optional practices to contribute toward meeting overall point total (18 required).

Practices	Points Available	
802.6.4(1) Smart Irrigation Controller	Mandatory	☐
802.6.5(5) Irrigation Flow Sensing Device	3	☐
802.10.1(1) Automated Motorized Non-Permeable Pool Cover	10 (SF Only)	☐
803.3(1-2) Automatic Leak Detection and Control Device	2	

SECTION 4: VENTILATION & HUMIDITY CONTROL

Requirements:

Select optional practices to contribute toward meeting overall point total (18 required).

Practices	Points Available	
706.12 Smart Ventilation	1	**0**
905.1 Humidity Monitoring System	2	**0**

Additional Requirements

Identify smart home features and potential for conserving energy or water in homeowner or multifamily occupant manual. ☐

Total Points:
1

need 17 more

Universal Design

Not Earned

UNIVERSAL DESIGN

Requirements:

Meet mandatory practices.

Practices

612.3(1) No-step entrance	**Not Met**
612.3(2) Accessible route from entrance to visiting room and bathroom	**Not Met**
612.3(3) Accessible route from entrance to bedroom	**Not Met**
612.3(4) Blocking or equivalent installed for future installation of grab bars	**Not Met**
612.3(5) Door handles are levers	**Met**
612.3(6) Sink, lavatory, and exterior door handles comply with ICC A117.1	**Not Met**
612.3(7) Power receptacles placed 15-48" above finished floor	**Not Met**
612.3(8) Light switches are rocker-style switches	**Not Met**
612.3(9) Wireless or voice-activated control of HVAC, lighting, alarm systems, window treatments, or door locks	**Not Met**

Wellness

Not Earned

SECTION 1: AIR

Requirements:

Meet all applicable mandatory practices.

Meet at least 3 optional practices. These practices contribute toward meeting the overall point total (29 required).

Practices	Points Available	
901.1.1 Natural draft furnaces and boilers not located in conditioned space	Mandatory	
901.1.5 Vented Natural Gas and Propane Fireplaces	Mandatory	
902.2.1 Building Ventilation Systems	Mandatory	**Not Met**
901.15(1-2) Non-Smoking Areas	Mandatory (MF)	**Not Met**
901.1.2 Air handling equipment not installed in garage	Mandatory	**Met**
902.1.6 Ventilation for Multifamily Common Spaces	3 (MF Only)	**0**
901.2.2 No Fireplaces, Woodstoves, Pellet Stoves, or Masonry Heaters are Installed	6	**6**
902.4 HVAC System Protection	3	**3**
904.1 IAQ During Construction	2	**2**
904.2 IAQ Post-Construction	3	**3**
706.12 Smart Ventilation	1	**0**
902.2.4 MERV Filters 14 or Greater	3	**0**

SECTION 2: MOVEMENT

Requirements:

Select at least one item from Group A.

Select optional practices from Group B to contribute toward meeting overall point total (29 required).

Practices		
GROUP A		
501.2(3) Pedestrian Activity		
501.2(4) Walkability		**Met**
505.10(a) Indoor area for adult exercise and/or children's play equipment (MF Only)		
505.10(b) Courtyard, garden, terrace, or roof space for play/recreation (MF Only)		
Exception : single-family homes unable to comply with 501.2(3) or 501.2(4) due to the low surrounding developmental density can meet this requirement if they demonstrate that they are within walking distance (0.5 mile) from a community facility that meet the intent of 505.10(a) or 505.10(b), such as a public park or sports facility.		
GROUP B	Points Available	
501.2(5) Bicycle Use	5	**0**
501.2(6) Bicycle Parking	2-8 (MF Only)	**0**
501.2(1) Pedestrian access to mass transit system	6	**0**
501.2(8) Access to bike sharing program	5	**0**
505.4 Mixed-use development	8 (MF Only)	**0**

SECTION 3: MOISTURE MANAGEMENT

Requirements:

Meet mandatory practice.

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available	
602.1.7.1(1, 3) Moisture Control Measures	Mandatory	**Met**
602.1.12 Roof Overhangs	4 (SF Only)	**0**
602.1.10 Exterior Doors	2-6	**0**

SECTION 4: COMFORT

Requirements:

Meet mandatory practice.

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available	
903.3 Relative humidity	Mandatory	
905.1 Humidity monitoring system	2	**0**

SECTION 5: NOURISHMENT

Requirements:

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available	
505.5(a) Community garden	3-9 (MF Only)	**0**
505.5(b) Proximity to market/farm stand	3 (MF Only)	**0**

SECTION 6: LIGHT

Requirements:

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available	
703.7.2 Window Shading	1	**0**
706.1(5) Lighting Control System	1	**0**

SECTION 7: SOUND

Requirements:

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available	
905.4 Sound Barrier	1-3	**0**

SECTION 8: MATERIALS

Requirements:

Achieve a minimum of 15 points from the following practices. These practices contribute toward meeting the overall point total (29 required).

Practices	Points Available	
612.2 Sustainable Products	3-9	**0**
901.5 Low/no- formaldehyde cabinets	3-8	**0**
901.7 Low-emission floor materials	1-8	**0**
901.8 Low-emission wall coverings	4	**0**
901.12 Low-VOC furniture and furnishings	2 (MF Only)	**0**

SECTION 9: ACCESS TO NATURE

Requirements:

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available	
503.6(1) Wildlife gardens	3	**0**
503.6(2) Certified backyard wildlife	3	**0**
503.6(3) Wildlife corridor or other preserved area	3	**0**

Total Points:

14
need 15 more

Zero Water	Not Earned

WRI: **WRI not Entered**

WaterSense: Not Earned

There is mandatory information or practices missing from this Page!

Home Address:	Nw Sloan & NE Sycamore, Lees Summit, Missouri 64064
Community/Lot #:	Douglas Station

Notes:

WaterSense

Not Earned

Performance or Prescriptive Path? Prescriptive Path

LEAKS:

Pressure-loss test on all water supplies detects no leaks.	☐	
Free of visible leaks from hot water delivery system.	☐	
Free of visible leaks from toilet(s), as determined through visual assessment and by conducting a dye tablet test in each toilet to ensure the flapper is not leaking.	☐	
Free of visible leaks from bathroom faucets(s).	☐	
Free of visible leaks from showerhead(s).	☐	
Free of visible leaks from bathroom tub faucet(s), i.e., tub spout(s), when showerhead(s) is activated, as determined through visual assessment after showerhead has been activated for one minute.	☐	
Free of visible leaks from kitchen and other sink faucet(s).	☐	
Free of visible leaks from other fixtures or appliances (e.g., clothes washers, dishwashers, hose bibs, irrigation systems) at point of use of connection to water distribution system.	☐	

GRESB Checklist

The Global Real Estate Sustainability Benchmarking, or GRESB, is a framework that measures the ESG (Environmental, Social and Governance) performance of a company's real estate portfolio. Real estate developers and property managers will self-report their building performance and operations information to GRESB, where it is validated and benchmarked against the companies' peers. To learn more about GRESB, visit www.gresb.com.

Green building certifications like NGBS Green offer credible validation of ESG efforts and can contribute toward a higher GRESB score and/or ranking. By pursuing NGBS Green Certification, investors and property managers can fulfill many indicators within the "Development" section of GRESB. Visit www.HomeInnovation.com/ESG to learn more.

This NGBS-GRESB checklist identifies the GRESB indicators that are fulfilled by NGBS compliance. The checklist is for informational purposes; GRESB indicators that are "met" on this checklist are not guaranteed. When reporting to GRESB, proper and sufficient evidence is required to receive credit.

	DRE1 ESG strategy during development
☐	• Biodiversity and habitat
	• Building safety
	• Climate/climate change adaptation
☐	• Energy consumption
☑	• Green building certifications
	• Greenhouse gas emissions
☐	• Health and well-being
☑	• Indoor environmental quality
☐	• Life-cycle assessments/embodied carbon
☑	• Location and transportation
☑	• Material sourcing
☐	• Net-zero/carbon neutral design
☑	• Pollution prevention
☐	• Renewable energy
☑	• Resilience to catastrophe/disaster
☑	• Site selection and land use
☐	• Sustainable procurement
☐	• Waste management
☐	• Water consumption

	DRE2 Site selection requirements
☑	• Connect to multi-modal transit networks
☑	• Locate projects within existing developed areas
☐	• Protect, restore, and conserve aquatic ecosystems
☐	• Protect, restore, and conserve farmland
☑	• Protect, restore, and conserve floodplain functions
☐	• Protect, restore, and conserve habitats for native, threatened and endangered species
	• Protect, restore, and conserve historical and heritage sites
☐	• Redevelop brownfield sites

	DRE3 Site Design and Construction Requirements
☐	• Manage waste by diverting construction and demolition materials from disposal
☐	• Manage waste by diverting reusable vegetation, rocks, and soil from disposal
	• Minimize light pollution to the surrounding community

	• Minimize noise pollution to the surrounding community
☑	• Perform environmental site assessment
	• Protect air quality during construction
☑	• Protect and restore habitat and soils disturbed during construction and/or during previous development
☑	• Protect surface water and aquatic ecosystems by controlling and retaining construction pollutants

	DMA1 Materials selection requirements
	Requirement for disclosure about the environmental and/or health attributes of building materials
☐	• Environmental Product Declarations
	• Health Product Declarations
	Material characteristics specification
☑	• Locally extracted or recovered materials
☐	• Low embodied carbon materials
☑	• Low-emitting VOC materials
☐	• Materials and packaging that can easily be recycled
☐	• Materials that disclose environmental impacts
	• Materials that disclose potential health hazards
☑	• Rapidly renewable materials and recycled content materials
	• "Red list" of prohibited materials or ingredients that should not be used on the basis of their human and/or
☐	• Third-party certified wood-based materials and products

	DMA2.1 Life cycle assessments
☐	*Does the entity assess the life cycle emissions of its development projects?*

	DEN1 Energy efficiency requirements
	Requirements for planning and design include
	• Development and implementation of a commissioning plan
☑	• Integrative design process
☑	• To exceed relevant energy codes or standards
	• Requirements for minimum energy use intensity post-occupancy
	Common energy efficiency measures
☑	• Air conditioning
	• Commissioning
	• Energy modeling
☐	• High-efficiency equipment and appliances
☑	• Lighting
☑	• Occupant controls
☐	• Passive Design
☐	• Space Heating
	• Ventilation
☐	• Water Heating
	Operational energy efficiency monitoring
☐	• Building energy management systems
☐	• Energy use analytics
☐	• Post-construction energy monitoring
☑	• Sub-meter

	DEN2.1 On-site renewable energy
☐	• Average design target for the fraction of total energy demand met with on-site renewable energy

DEN2.2 Net zero carbon design and standards

Does the entity's portfolio include any buildings designed to meet net zero carbon?

The entity's definition of "net zero carbon" includes:

☐ • Net zero carbon - construction
• Net zero carbon - operational energy
• Other: _____

The entity uses net zero carbon code/standard:

☐ • National/local green building council standard
• National/local government standard
• International standard
• Other: _____

DWT1 Water conservation strategy

Requirements for planning and design

• Development and implementation of a commissioning plan
☑ • Integrative design for water conservation
☑ • Requirements for indoor water efficiency
☑ • Requirements for outdoor water efficiency
☑ • Requirements for process water efficiency
☑ • Requirements for water supply
• Requirements for minimum water use intensity post-occupancy

Common water efficiency measures

☐ • Commissioning of water systems
☐ • Drip/smart irrigation
☐ • Drought tolerant/low-water landscaping
☑ • High-efficiency/dry fixtures
☐ • Leak detection system
☐ • Occupant sensors
☐ • On-site wastewater treatment
☐ • Reuse of stormwater and greywater for non-potable applications

Operational water efficiency monitoring

• Post-construction water monitoring
☐ • Sub-meter
• Water use analytics

DWS1 Waste management strategy

Management and construction practices

Construction waste signage
☐ Diversion rate requirements
☑ Education of employees/contractors on waste management
Incentives for contractors for recovering, reusing and recycling building materials
Targets for waste stream recovery, reuse and recycling
☐ Waste management plans
☐ Waste separation facilities

On-site waste monitoring

☑ Hazardous waste monitoring/audit
☐ Non-hazardous waste monitoring/audit

DSE1 Health and Well-being

Requirements for planning and design

- Health Impact Assessment
- Integrated planning process
- Other planning processes

Common occupant health and well-being measures

- ☐ Acoustic comfort
- ☑ Active design features
- ☐ Biophilic design
- ☑ Commissioning
- ☐ Daylight
- Ergonomic workplace
- ☐ Humidity
- ☑ Illumination
- ☑ Inclusive design
- ☐ Indoor air quality
- ☑ Natural ventilation
- ☑ Occupant controls
- ☐ Physical activity
- ☐ Thermal comfort
- ☑ Water quality

Provisions to verify health and well-being performance include

- ☑ Occupant education
- Post-construction health and well-being monitoring (e.g. occupant comfort and satisfaction)

DBC1.1 Green building standard requirements

Does the entity's development portfolio include projects that are aligned with green building rating standards?

require certification

- 2-The entity requires projects to achieve certification with a green building rating system but does not require a
- ☑ 3-The entity requires projects to achieve a specific level of certification

NGBS GREEN
Home Innovation Research Labs

Instructions: Verify all Designer inputs are correct using checkboxes. If incorrect, provide correct information.

Overview (Verifier phase)	Designer	Correct?	Correction	Final	
Project ID:					
Builder Name:	Douglas Station Partners	☐			**Climate Zone:**
Physical Address of Home:	Nw Sloan & NE Sycamore	☐			!! !! !! !!
Community/Lot #:	Douglas Station	☐			
City:	Lees Summit	☐			
State:	Missouri	☐			**Radon**
County:	Jackson	☐			!!
Zip:	64064	☐			
Single-Family or Multifamily:	Multifamily	☑		Multifamily	
	154	☐			
	No	☐			
	Douglas Station	☐			
Above grade plane finished floor area:	860	☐	s.f./unit	s.f./unit	Calculate per ANSI Z765. For a multifamily building, use a
Total conditioned floor area:	130776	☐	s.f.	s.f.	weighted average of the individual unit sizes.
Stories above grade:	3	☐			
Project Elevation (ft. above sea level):	670	☐	ft.	ft.	
Project Description (optional):	New construction portion of the project:	☐			
	scored from plans dated 9/23/2022, Rev				
Foundation Type:	Slab on grade	☐			
					If "Other", please explain:
Type of Heating System (main system):	Heat Pump	☐			
Type of Heating System (system 2):	None	☐			
Type of Heating System (system 3):	None	☐			
Primary Heating Fuel:	Electricity	☐			
Heating Ducts:	Ducted	☐			
Type of Cooling System (main system):	Heat Pump	☐			
Type of Cooling System (system 2):	None	☐			
Type of Cooling System (system 3):	None	☐			
Cooling Ducts:	Ducted	☐			
Maximum window and door SHGC:	0.3	☐			
Maximum skylight SHGC:	0	☐			
Maximum window and door U-value:	0.32	☐			
Maximum skylight U-value:	0	☐			If "Other", please explain:
Renewable Energy:	None	☐			
Thermal Envelope Insulation:	Fiberglass	☐			
Attic Type:	Sealed	☐			
Attached Garage:	No	☐			
Recessed Lighting:	No	☐			
Special Design Features:					
Passive Solar:	No	☐			
Mass Walls:	No	☐			
Radiant/Hydronic:	No	☐			
Tankless Water Heater:	No	☐			
Composting Toilet:	No	☐			
					If "Other", please explain:
Local Energy Code:	2018 IECC	☐			
Local Building Code:	2018 IBC	☐			

Filters

Goal Level:

Goal Level: None Chosen, Overall Level: None

Points to Goal Level: Ch5: 0, Ch6: 0, Ch7: 0, Ch8: 0, Ch9: 0, Ch10: 0

Add'l Pts above goal level: Ch5: 0, Ch6: 0, Ch7: 0, Ch8: 0, Ch9: 0, Ch10: 0

Report Phase:

Version: 5.2.20

Rev. Date: 2/28/2024

NGBS GREEN Home Innovation Research Labs

Mandatory Information is missing on the Overview (Verification) page!

There is mandatory information or practices missing from this Page!

Home Address:

Community/Lot #:

Chapter	Points	R/F	Practice #	Practice	Points Available	Points Claimed	Points Awarded	Status	Verifier Notes	Design Phase Notes
5		RF		**500 LOT DESIGN, PREPARATION AND DEVELOPMENT**						
5			**500.0**	**500.0 Intent.** This section applies to lot development for the eventual construction of residential buildings, multifamily buildings, or additions thereto that contain dwelling units or sleeping units.						
5	P	RF		**501 LOT SELECTION**						
5	P	RF	**501.1**	**501.1 Lot.** Lot is selected in accordance with § 501.1(1) or § 501.1(2).		10	0	Certified Site:		None
5	P	RF	**(1)**	A lot is selected within a site certified to this Standard or equivalent	**15**			☐		
5	P	RF	**(2)**	A lot is selected to minimize environmental impact by one or more of the following:						
5	P	RF	**(a)**	An infill lot is selected.	**10**			☐		
5	P	RF	**(b)**	A lot is selected that is a greyfield.	**10**			☐		
5	P	RF	**(c)**	An EPA-recognized brownfield lot is selected.	**15**			☐		
5	P	RF	**501.2**	**501.2 Multi-modal transportation.** A range of multi-modal transportation choices are promoted by one or more of the following:						None
5	P	RF								
5		RF	**(1)**	A lot is selected within one-half mile (805 m) of pedestrian access to a mass transit system	**6**	0	0	☐		None
5		RF								
5		RF	**(2)**	A lot is selected within five miles (8,046 m) of a mass transit station with provisions for parking.	**3**	0	0	☐		None
5		RF								
5		RF	**(3)**	Walkways, street crossings, and entrances designed to promote pedestrian activity are provided. New buildings are connected to existing sidewalks and areas of development.	**5**	0	0	☐		None
5		RF								
5	P	RF	**(4)**	A lot is selected within one-half mile (805 m) of six or more community resources No more than two each of the following use category can be counted toward the total: Recreation, Retail, Civic, and Services. Examples of resources in each category include, but are not limited to the following:				☐		bank, grocery, gas, hospital, retail, church, restaurant
5	P	RF								
5	P	RF								
5	P	RF								
5	P	RF		Recreation: recreational facilities (such as pools, tennis courts, basketball courts), parks.	**4**	4	0			
5	P	RF		Retail: grocery store, restaurant, retail store.						
5	P	RF		Civic: post office, place of worship, community center.						
5	P	RF		Services: bank, daycare center, school, medical/dental office, laundromat/dry cleaners.						
5	P	RF		NOTE: List the 6 community resources in the Notes field.						
5	P	RF		OR						
5		RF		A lot is selected within a census block group that, compared to its region, has above-average neighborhood walkability using an index within the EPA's Smart Location Database:		0	0			None
5		RF								
5		RF								
5		RF		(a) Walkability is within the top quartile for the region.	**5**					
5		RF		(b) Walkability is within the second quartile for the region.	**2**					
5		RF	**(5)**	Bicycle use is promoted by building on a lot located within a community that has rights-of-way specifically dedicated to bicycle use in the form of paved paths or bicycle lanes, or on an infill lot located within 1/2 mile of a bicycle lane designated by the jurisdiction.	**5**	0	0	☐		None
5		RF								
5		RF	**(6)**	Dedicated bicycle parking and racks are indicated on the site plan and constructed for mixed-use and multifamily buildings:		0	0			None
5		RF								
5		RF	**(a)**	Minimum of 1 bicycle parking space per 3 residential units	**2**					
5		RF	**(b)**	Minimum of 1 bicycle parking space per 2 residential units	**4**					
5		RF	**(c)**	Minimum of 1 bicycle parking space per 1 residential unit.	**6**					
5		RF	**(d)**	Bicycle enclosed storage is provided or parking spaces are covered or otherwise protected from the elements	**2 per (a)-(c)**	0	0	☐		None
5		RF								
5		RF	**(7)**	Select a lot in a community where there is access to shared vehicle usage such as carpool drop-off areas, car-share services, and shuttle services to mass transit.	**5**	0	0	☐		None
5		RF								
5		RF		NOTE: Enter name of car sharing program.						
5		RF	**(8)**	Lot is within 1/2 mile walking distance of where a bike sharing program is provided.	**5**	0	0	☐		None
5		RF		NOTE: Enter name of bike sharing program.						
5	P	RF		**502 PROJECT TEAM, MISSION STATEMENT, AND GOALS**						
5	P	RF	**502.1**	**502.1 Project team, mission statement, and goals.** A knowledgeable team is established and team member roles are identified with respect to green lot design, preparation, and development. The project's green goals and objectives are written into a mission statement.	**4**	4	0	☐		None
5	P	RF								
5	P	RF								
5	P	RF								
5	P	RF		**503 LOT DESIGN**						
5			**503.0**	**503.0 Intent.** The lot is designed to avoid detrimental environmental impacts first, to minimize any unavoidable impacts, and to mitigate for those impacts that do occur. The project is designed to minimize environmental impacts and to protect, restore, and enhance the natural features and environmental quality of the lot.						None
5				**(Points awarded only if the intent of the design is implemented.)**						
5		R	**503.1**	**503.1 Natural resources.** Natural resources are conserved by one or more of the following:						None
5		R	**(1)**	A natural resources inventory is completed under the direction of a qualified professional.	**5**	0	0	☐		
5		R								
5		R	**(2)**	A plan is implemented to conserve the elements identified by the natural resource inventory as high-priority resources.	**6**	0	0	☐		
5		R								
5		R	**(3)**	Items listed for protection in the natural resource inventory plan are protected under the direction of a qualified professional.	**4**	0	0	☐		
5		R								
5		R	**(4)**	Basic training in tree or other natural resource protection is provided for the on-site supervisor.	**4**	0	0	☐		
5		R								
5		R	**(5)**	All tree pruning on-site is conducted by a certified arborist or other qualified professional.	**3**	0	0	☐		
5		R								
5		R	**(6)**	Ongoing maintenance of vegetation on the lot during construction is in accordance with TCIA A300 or locally accepted best practices.	**4**	0	0	☐		
5		R								
5		R	**(7)**	Where a lot adjoins a landscaped common area, a protection plan from construction activities next to the common area is implemented.	**5**	0	0	☐		
5		R								
5		R	**(8)**	Developer has a plan to design and construct the lot in accordance with the International Wildland-Urban Interface Code (IWUIC).				☐		
5		R		*[Only applicable where the AHJ has not declared a wildland-urban interface area, but a fire protection engineer, certified fire marshal, or other qualified party has determined and documented the site as hazarded per the IWUIC].*	**6**	0	0			
5		R								
5		RF	**503.2**	**503.2 Slope disturbance.** Slope disturbance is minimized by one or more of the following:				Max Slope in Const. Zn:		None
5		RF		Note: Points are only available for lots with slopes of 25% or greater.						
5		RF	**(1)**	The use of terrain adaptive architecture.	**5**	0	0	☐		
5		RF	**(2)**	Hydrological/soil stability study is completed and used to guide the design of all buildings on the lot.	**5**	0	0	☐		
5		RF								
5		RF	**(3)**	All or a percentage of driveways and parking are aligned with natural topography to reduce cut and fill.		0	0			
5		RF								
5		RF	**(a)**	10 percent to < 25 percent	**1**					
5		RF	**(b)**	25 percent to 75 percent	**4**					
5		RF	**(c)**	greater than 75 percent	**6**					
5		RF	**(4)**	Long-term erosion effects are reduced through the design and implementation of clustering, terracing, retaining walls, landscaping, or restabilization techniques.	**6**	0	0	☐		
5		RF								
5		RF	**(5)**	Underground parking uses the natural slope for parking entrances.	**5**	0	0	☐		
5	P	R	**503.3**	**503.3 Soil disturbance and erosion.** Soil disturbance and erosion are minimized by one or more of the following: (also see Section 504.3)						None
5	P	R								
5	P	R		Note: Points must be earned in 503.3 in order for points in 504.1 to be available						
5	P	R	**(1)**	Construction activities are scheduled such that disturbed soil that is to be left unworked for more than 21 days is stabilized within 14 days..	**5**	5	0	☐		
5	P	R								
5	P	R	**(2)**	At least 75% of total length of the utilities on the lot are designed to use one or more alternative means:						
5	P	R								
5	P	R	**(a)**	tunneling instead of trenching				☐		
5	P	R	**(b)**	use of smaller (low ground pressure) equipment or geomats to spread the weight of construction equipment	**5**	5	0	☐		
5	P	R								
5	P	R	**(c)**	shared utility trenches or easements				☐		
5	P	R	**(d)**	placement of utilities under paved surfaces instead of yards				☐		
5	P	R	**(3)**	Limits of clearing and grading are demarcated on the lot plan.	**5**	5	0	☐		
5	P	RF	**503.4**	**503.4 Stormwater Management.** The stormwater management system is designed to use low impact development/green infrastructure practices to preserve, restore or mitigate changes in						None
5	P	RF								

5	P	RF			site hydrology due to land disturbance and the construction of impermeable surfaces through the use of one or more of the following techniques:							
5	P	RF			NOTE: For lots in a development, the points for 503.4 may be awarded for the lot when there is a community storm water management plan implemented and the builder does not violate that plan with respect to water leaving the lot.							
5	P	R		(1)	A site assessment is conducted and a plan prepared and implemented that identifies important existing permeable soils, natural drainage ways and other water features, e.g., depressional storage, onsite to be preserved in order to maintain site hydrology.	7	7	0	☐			need soils engineer report
5	P	R		(2)	A hydrologic analysis is conducted that results in the design of a stormwater management system that maintains the pre-development (stable, natural) runoff hydrology of the site through the development or redevelopment process. Ensure that post construction runoff rate, volume and duration do not exceed predevelopment rates, volume and duration.	10	0	0	☐			None
5		R		(3)	Low Impact Development/Green infrastructure stormwater management practices to promote infiltration and evapotranspiration are used to manage rainfall on the lot and prevent the off-lot discharge of runoff from all storms up to and including the volume of following storm events:		0	0				None
5		R		(a)	80th percentile storm event	5						
5		R		(b)	90th percentile storm event	8						
5		R		(c)	95th percentile storm event	10						
5		RF		(4)	Permeable materials are used for driveways, parking areas, walkways, patios, and recreational surfaces and the like according to the following percentages:		0	0				None
5		RF		(a)	10 percent to less than 25 percent (add 2 points for use of vegetative paving system)	5						
5		RF		(b)	25-50 percent (add 4 points for use of vegetative paving system)	8						
5		RF		(c)	Greater than 50 percent (add 6 points for use of vegetative paving system)	10						
5		RF			[Points for vegetative paving systems are only awarded for locations receiving more than 20 inches per year of annual average precipitation]	0	0	0	☐			None
5	P	RF		(5)	Complete gutter and downspout system directs storm water away from foundation to vegetated landscape area, a raingarden, or catchment system that provides for water infiltration.	3	3	0	☐			None
5	P	F	503.5		**503.5 Landscape plan.** A plan for the lot is developed to limit water and energy use while preserving or enhancing the natural environment.							None
5	P	F			(Where "front" only or "rear" only plan is implemented, only half of the points (rounding down to a whole number) are awarded for Items (1)-(9))							
5		F		(1)	A plan is formulated and implemented that protects, restores, or enhances natural vegetation on the lot.		0	0				None
5		F		(a)	100 percent of the natural area	0						
5		F		(b)	50 percent of the natural area	0						
5		F		(c)	25 percent of the natural area	0						
5		F		(d)	12 percent of the natural area	0						
5		F		(2)	Non-invasive vegetation that is native or regionally appropriate for local growing conditions is selected to promote biodiversity.	0	0	0	☐			None
5		F		(3)	To improve pollinator habitat, at least 10 percent of planted areas are composed of native or regionally appropriate flowering and nectar producing plant species. Invasive plant species shall not be utilized.	0	0	0	☐			None
5		F		(4)	EPA WaterSense Water Budget Tool or equivalent is used when implementing the site vegetative design.	0	0	0	☐			None
5		F		(5)	Where turf is being planted, Turfgrass Water Conservation Alliance (TWCA) or equivalent as determined by the adopting entity third party qualified water efficient grasses are used.	0	0	0	☐			None
5		F		(6)	For landscaped vegetated areas, the maximum percentage of turf area is:		0	0				None
5		F		(a)	0 percent	0						
5		F		(b)	Greater than 0 percent to less than 20 percent	0						
5		F		(c)	20 percent to less than 40 percent	0						
5		F		(d)	40 percent to 60 percent	0						
5	P	F		(7)	Plants with similar watering needs are grouped (hydrozoning) and shown on the lot plan.	0	5	0	☐			None
5		F		(8)	Summer shading by planting installed to shade a minimum of 30 percent of building walls. To conform to summer shading, the effective shade coverage (five years after planting) is the arithmetic mean of the shade coverage calculated at 10 am for eastward facing walls, noon for southward facing walls, and 3 pm for westward facing walls on the summer solstice.	0	0	0	☐			None
5		F		(9)	Vegetative wind breaks or channels are designed to protect the lot and immediate surrounding lots as appropriate for local conditions.	0	0	0	☐			None
5		F		(10)	Site or community generated tree trimmings or stump grinding of regionally appropriate trees are used on the lot to provide protective mulch during construction or for landscaping.	3	0	0	☐			None
5		F		(11)	An integrated pest management plan is developed to minimize chemical use in pesticides and fertilizers.	4	0	0	☐			None
5		F		(12)	Developer has a plan for removal or containment of invasive plants from the disturbed areas of the site.	3	0	0	☐			None
5		F		(13)	Developer implements a plan for removal or containment of invasive plants on the undisturbed areas of the site.	6	0	0	☐			None
5		F	503.6		**503.6 Wildlife habitat.** Measures are planned to support wildlife habitat and include at least two of the following:		0	0				None
5		F		(1)	Plants and gardens that encourage wildlife, such as bird and butterfly gardens.	3			☐			
5		F		(2)	Inclusion of a certified "backyard wildlife" program.	3			☐			
5		F		(3)	The lot is adjacent to a wildlife corridor, fish and game park, or preserved areas and is designed with regard for this relationship.	3			☐			
5		F		(4)	Outdoor lighting techniques are utilized with regard for wildlife.	3			☐			
5		RF	503.7		**503.7 Environmentally sensitive areas.** The lot is in accordance with one or both of the following:		4	0				None
5		RF		(1)	The lot does not contain any environmentally sensitive areas that are disturbed by the construction.	4						
5		RF		(2)	On lots with environmentally sensitive areas, mitigation and/or restoration is conducted to preserve ecosystem functions lost through development and construction activities.	4						
5		R	503.8		**503.8 Demolition of existing building.** A demolition waste management plan is developed, posted at the jobsite, and implemented to recycle and/or salvage with a goal of recycling or salvaging a minimum of 50 percent of the nonhazardous demolition waste.	5	0	0				None
5		R			(One additional point awarded for every 10 percent of nonhazardous demolition waste recycled and/or salvaged beyond 50 percent).	1 additional						
5	P	RF	504 LOT CONSTRUCTION										
5			504.0		**504.0 Intent.** Environmental impact during construction is avoided to the extent possible; impacts that do occur are minimized and any significant impacts are mitigated.							
5	P	RF	504.1		**504.1 On-site supervision and coordination.** On-site supervision and coordination is provided during on-the-lot clearing, grading, trenching, paving, and installation of utilities to ensure that specified green development practices are implemented. (also see Section 503.3)	4	4	0	☐			None
5	P	RF			NOTE: Points must be taken in 503.3 to claim points in 504.1.							
5		R	504.2		**504.2 Trees and vegetation.** Designated trees and vegetation are preserved by one or more of the following:							None
5		R		(1)	Fencing or equivalent is installed to protect trees and other vegetation.	3	0	0	☐			
5		R		(2)	Trenching, significant changes in grade, and compaction of soil and critical root zones in all "tree save" areas as shown on the lot plan are avoided.	5	0	0	☐			
5		R		(3)	Damage to designated existing trees and vegetation is mitigated during construction through pruning, root pruning, fertilizing, and watering.	4	0	0	☐			
5	P	RF	504.3		**504.3 Soil disturbance and erosion implementation.** On-site soil disturbance and erosion are minimized by one or more of the following in accordance with the SWPPP or applicable plan: (also see Section 503.3)							None
5	P	R		(1)	Sediment and erosion controls are installed on the lot and maintained in accordance with the stormwater pollution prevention plan, where required.	5	5	0	☐			None
5	P	R		(2)	Limits of clearing and grading are staked out on the lot.	5	5	0	☐			None
5		R		(3)	"No disturbance" zones are created using fencing or flagging to protect vegetation and sensitive areas on the lot from construction activity.	5	0	0	☐			None
5		R		(4)	Topsoil from either the lot or the site development is stockpiled and stabilized for later use and used to establish landscape plantings on the lot.	5	0	0	☐			None
5		R		(5)	Soil compaction from construction equipment is reduced by distributing the weight of the				☐			None

5	R				equipment over a larger area (laying lightweight geogrids, mulch, chipped wood, plywood, OSB, metal plates, or other materials capable of weight distribution in the pathway of the equipment).	4	0	0				
5 P	R		(6)		Disturbed areas on the lot that are complete or to be left unworked for 21 days or more are stabilized within 14 days using methods as recommended by the EPA or in the approved SWPPP, where required.	3	3	0	☐			None
5	RF		(7)		Soil is improved with organic amendments or mulch.	3	0	0	☐			None
5 P	RF		(8)		Utilities on the lot are installed using one or more alternative means:							None
5 P	RF				tunneling instead of trenching,				☐			
5 P	RF				use of smaller equipment,				☐			
5 P	RF				use of low ground pressure equipment,	5	5	0	☐			
5 P	RF				use of geomats,				☐			
5 P	RF				shared utility trenches or easements,				☐			
5 P	RF				other.				☐			
5 P	RF				NOTE: List "other" means of installing utilities in the assigned Notes area.							
5	RF		(9)		Inspection reports of stormwater best management practices are available.	3	0	0	☐			None
5 P	RF	505 INNOVATIVE PRACTICES										
5		505.0			**505.0 Intent.** Innovative lot design, preparation, and development practices are used to enhance environmental performance. Waivers or variances from local development regulations are obtained and innovative zoning is used to implement such practices.							
5 P	F	505.1			**505.1 Driveways and parking areas.** Driveways and parking areas are minimized or mitigated by one or more of the following:							
5 P	F		(1)		Off-street parking areas are shared or driveways are shared. Waivers or variances from local development regulations are obtained to implement such practices, if required.	5	5	0	☐			None
5	F		(2)		In a multifamily project, parking capacity does not exceed the local minimum requirements.	5	0	0	☐			None
5	F		(3)		Structured parking is utilized to reduce the footprint of surface parking areas.		0	0				None
5	F			(a)	25 percent to less than 50 percent	4						
5	F			(b)	50 percent to 75 percent	5						
5	F			(c)	greater than 75 percent	6						
5	F	505.2			**505.2 Heat island mitigation.** Heat island effect is mitigated by the following.							
5	F		(1)		Hardscape: Not less than 50 percent of the surface area of the hardscape on the lot meets one or a combination of the following methods.	5	0	0				None
5	F			(a)	Shading of hardscaping: Shade is provided from existing or new vegetation (within five years) or from trellises. Shade of hardscaping is to be measured on the summer solstice at noon.				☐			
5	F			(b)	Light-colored hardscaping: Horizontal hardscaping materials are installed with a solar reflectance index (SRI) of 29 or greater. The SRI is calculated in accordance with ASTM E1980. A default SRI value of 35 for new concrete without added color pigment is permitted to be used instead of measurements.				☐			
5	F			(c)	Permeable hardscaping: Permeable hardscaping materials are installed.				☐			
5	F		(2)		Roofs: Not less than 75 percent of the exposed surface of the roof is vegetated using technology capable of withstanding the climate conditions of the jurisdiction and the microclimate conditions of the building lot. Invasive plant species are not permitted.	5	0	0	☐			None
5 P	RF	505.3			**505.3 Density.** The average density on the lot on a net developable area basis is:		5	0				154 units on 7.5 Ac = 20 units/Ac
5 P	RF		(1)		7 to less than 14 dwelling units/sleeping units per acre (per 4,047 m2)	4						
5 P	RF		(2)		14 to less than 21 dwelling units/sleeping units per acre (per 4,047 m2)	5						
5 P	RF		(3)		21 to less than 35 dwelling units/sleeping units per acre (per 4,047 m2)	6						
5 P	RF		(4)		35 to less than 70 dwelling units/sleeping units per acre (per 4,047 m2)	7						
5 P	RF		(5)		70 or greater dwelling units/sleeping units per acre (per 4,047 m2)	8						
5	RF	505.4			**505.4 Mixed-use development.**							
5	RF		(1)		The lot contains a mixed-use building.	8	0	0	☐			None
5	RF	505.5			**505.5 Multifamily & mixed-use community garden(s).** A portion of the lot is established as a community garden(s), available to residents of the lot, to provide for local food production to residents or area consumers.							
5	RF								Community Garden (sf):			
5	RF			(a)	A portion of the lot of at least 250 sq ft is established as community garden(s) for the residents of the site. [*3 points per 250 sq ft]	9 max	0	0				None
5	RF			(b)	Locate the project within a 0.5-mile walking distance of an existing or planned farmers market/ farm stand that is open or will operate at least once a week for at least five months of the year.	3	0	0	☐			None
5	RF			(c)	Areas and physical provisions are provided for composting.	1	0	0	☐			None
5	RF			(d)	Signs designating the garden area are posted.	1	0	0	☐			None
5	F	505.6			**505.6 Multi-Unit Plug-In Electric Vehicle Charging.** Plug-in electric vehicle charging capability is provided for not fewer than 2 percent of parking stalls. [An additional 2 points can be earned for each percentage point above 2% for a maximum of 10 points] Fractional values shall be rounded up to the nearest whole number. Electrical capacity in main electric panels supports Level 2 charging (208/240V- up to 80 amps or in accordance with SAE J1772). Each stall is provided with conduit and wiring infrastructure from the electric panel to support Level 2 charging (208/240V- up to 80 amps or in accordance with SAE J1772) service to the designated stalls, and stalls are equipped with either Level 2 charging AC grounded outlets (208/240V- up to 80 amps or in accordance with SAE J1772) or Level 2 charging stations (208/240V- up to 80 amps or in accordance with SAE J1772) by a third party charging station. NOTE: SF/BTR homes are also eligible if 2% or more of the total of shared/communal/visitor parking stalls in the development/community have plug-in electric vehicle charging capability.	4 (10 max)	0	0				Will EV charging Stations be installed
5	F	505.7			**505.7 Multi-unit residential CNG vehicle fueling.** CNG vehicle residential fueling appliances are provided for at least 1 percent of the parking stalls. The CNG fueling appliances shall be listed in accordance with ANSI/CSA NGV 5.1 and installed in accordance with the appliance manufacturer's installation instructions. NOTE: Single-Family/Build-to-Rent homes are also eligible if 1% of the shared/communal/visitor parking stalls in the development have residential CNG vehicle refueling.	4		0	☐			None
5	RF	505.8			**505.8 Street network.** Locate the project in an area of high intersection density.	5	0	0	☐			None
5	F	505.9			**505.9 Smoking prohibitions.** Signs are provided on multifamily and mixed-use lots prohibiting smoking at the following locations: NOTE: Build-to-rent homes are also eligible for (a), (b) and (c) if smoking is prohibited and signs posted for all homes in the development/community. SF homes for sale are not eligible.				Build-to-Rent? ☐			
5	F			(a)	Smoking is prohibited within 25 feet (7.5 m) of all building exterior doors and operable windows or building air intakes within 15 (4.5 m) vertical feet of grade or a walking surface.	3	0	0	☐			None
5	F			(b)	Smoking is prohibited on decks, balconies, patios and other occupied exterior spaces.	3	0	0	☐			None
5	F			(c)	Smoking is prohibited at all parks, playgrounds, and community activity or recreational spaces.	3	0	0	☐			None
5	F	505.10			**505.10 Exercise & Recreation Area.** For multifamily buildings, on-site dedicated recreation space for exercise or play opportunities for adults and/or children open and accessible to residents is provided.							
5	F			(a)	A dedicated area of at least 400 square feet is provided inside the building with adult exercise and/or children's play equipment.	3	0	0	☐			None
5	F			(b)	A courtyard, garden, terrace, or roof space at least 10% of the lot area that can serve as outdoor space for children's play and /or adult activities is provided.	3	0	0	☐			None
5	F			(c)	Active play/recreation areas are illuminated at night to extend opportunities for physical activity into the evening.	3	0	0	☐			None

601 QUALITY OF CONSTRUCTION MATERIALS AND WASTE

601.0 **601.0 Intent.** Design and construction practices that minimize the environmental impact of the building materials are incorporated, environmentally efficient building systems and materials are incorporated, and waste generated during construction is reduced.

601.1	**601.1 Conditioned floor area.** Finished floor area of a dwelling unit or sleeping unit is limited. Finished floor area is calculated in accordance with ANSI Z765 for single family and ANSI/BOMA Z65.4 for multifamily buildings. Only the finished floor area for stories above grade plane is included in the calculation. [For every 100 square feet (9.29 m2) over 4,000 square feet (372 m2), one point is to be added to rating level points shown in Table 303, Category 7 for each rating level.]		12	0			None
(1)	less than or equal to 700 square feet (65 m^2)	**14**					
(2)	less than or equal to 1,000 square feet (93 m^2)	**12**					
(3)	less than or equal to 1,500 square feet (139 m^2)	**9**					
(4)	less than or equal to 2,000 square feet (186 m^2)	**6**					
(5)	less than or equal to 2,500 square feet (232 m^2)	**3**					
(6)	greater than 4,000 square feet (372 m^2)	**N/A**					
	(For every 100 square feet (9.29 m^2) over 4,000 square feet (372 m^2), one point is to be added to rating level points shown in Table 303, Category 7 for each rating level.)						
	Multifamily Building Note: For a multifamily building, a weighted average of the individual unit sizes is used for this practice.						
601.2	**601.2 Material usage.** Structural systems are designed or construction techniques are implemented that reduce and optimize material usage.						
(1)	Minimum structural member or element sizes necessary for strength and stiffness in accordance with advanced framing techniques or structural design standards are selected.	**3**	3	0	☐		Trusses
(2)	Higher-grade or higher-strength of the same materials than commonly specified for structural elements and components in the building are used and element or component sizes are reduced accordingly.	**3**	3	0	☐		Engineered wood
(3)	Performance-based structural design is used to optimize lateral force-resisting systems.	**3**	3	0	☐		Shear walls
601.3	**601.3 Building dimensions and layouts.** Building dimensions and layouts are designed to reduce material cuts and waste. This practice is used for a minimum of 80 percent of the following areas:						
(1)	floor area	**3**	0	0	☐		None
(2)	wall area	**3**	0	0	☐		None
(3)	roof area	**3**	0	0	☐		None
(4)	cladding or siding area	**3**	0	0	☐		None
(5)	penetrations or trim area	**1**	0	0	☐		None
601.4	**601.4 Framing and structural plans.** Detailed framing or structural plans, material quantity lists and on-site cut lists for framing, structural materials, and sheathing materials are provided.	**4**	0	0	☐		None
601.5	**601.5 Prefabricated components.** Precut or preassembled components, or panelized or precast assemblies are utilized for a minimum of 90 percent for the following system or building:	**13 Max**					
(1)	floor system	**4**	4	0	☐		Trusses
(2)	wall system	**4**	0	0	☐		None
(3)	roof system	**4**	4	0	☐		Trusses
(4)	modular construction for the entire building located above grade	**13**	0	0	☐		None
(5)	manufactured home construction for the entire building located above grade	**13**	0	0	☐		None
601.6	**601.6 Stacked stories.** Stories above grade are stacked, such as in 1½-story, 2-story, or greater structures. The area of the upper story is a minimum of 50 percent of the area of the story below based on areas with a minimum ceiling height of 7 feet (2,134 mm).	**8 Max**	6	0	from overview: no stacked stories		None
(1)	first stacked story	**4**					
(2)	for each additional stacked story	**2**					
601.7	**601.7 Prefinished materials. Prefinished building** materials or assemblies listed below have no additional site-applied finishing material are installed. **(Points awarded for each type of material or assembly.)**	**12 Max**	12	0			Windows, siding, flooring, cabinets
(a)	interior trim not requiring paint or stain						
(b)	exterior trim not requiring paint or stain						
(c)	window, skylight, and door assemblies not requiring paint or stain on one of the following surfaces:						
	i. exterior surfaces						
	ii. interior surfaces						
(d)	interior wall coverings or systems, floor systems, and/or ceiling systems not requiring paint or stain or other type of finishing application						
(e)	exterior wall coverings or systems, floor system, and/or ceiling systems not requiring paint or stain or other type of finishing application						
(1)	90 percent or more of the installed building materials or assemblies listed above:	**5**					
(2)	50 percent to less than 90 percent of the installed building material or assembly listed above:	**2**					
(3)	35 percent to less than 50 percent of the installed building material or assembly listed above:	**1**					
601.8	**601.8 Foundations.** A foundation system that minimizes soil disturbance, excavation quantities, and material usage, such as frost-protected shallow foundations, isolated pier and pad foundations, deep foundations, post foundations, or helical piles is selected, designed, and constructed. The foundation is used on 50 percent or more of the building footprint. NOTE: Indicate in the assigned Notes area the type designed and constructed: frost-protected shallow foundations, pier and pad foundations, post foundations, or other similar foundation type.	**3**	0	0	☐		None

602 ENHANCED DURABILITY AND REDUCED MAINTENANCE

602.0 **602.0 Intent.** Design and construction practices are implemented that enhance the durability of materials and reduce in-service maintenance.

602.1	**602.1 Moisture Management – Building Envelope**						
602.1.1	**602.1.1 Capillary breaks**						
602.1.1.1	**602.1.1.1** A capillary break and vapor retarder are installed at concrete slabs in accordance with ICC IRC Sections R506.2.2 and R506.2.3 or ICC IBC Sections 1907 and 1805.4.1.	**Mandatory**					None
602.1.1.2	**602.1.1.2** A capillary break between the footing and the foundation wall is provided to prevent moisture migration into foundation wall.	**3**	0	0	☐		None
602.1.2	**602.1.2 Foundation waterproofing.** Enhanced foundation waterproofing is installed using one or both of the following:	**4**	0	0			None
(1)	rubberized coating, or				☐		
(2)	drainage mat				☐		
602.1.3	**602.1.3 Foundation drainage**						
602.1.3.1	**602.1.3.1** Where required by the ICC IRC or IBC for habitable and usable spaces below grade, exterior drain tile is installed.	**N/A**			☐		None
602.1.3.2	**602.1.3.2** Interior and exterior foundation perimeter drains are installed and sloped to discharge to daylight, dry well, or sump pit.	**4**	0	0	☐		None
602.1.4	**602.1.4 Crawlspaces**						
602.1.4.1	**602.1.4.1** Vapor retarder in unconditioned vented crawlspace is in accordance with the following, as applicable. Joints of vapor retarder overlap a minimum of 6 inches (152 mm) and are taped.						
(1)	Floors. Minimum 6 mil vapor retarder installed on the crawlspace floor and extended at least 6 inches up the wall and is attached and sealed to the wall.	**6**	0	0	☐		None
(2)	Walls. Dampproof walls are provided below finished grade.	**N/A**					None
602.1.4.2	**602.1.4.2** Crawlspace that is built as a conditioned area is sealed to prevent outside air infiltration and provided with conditioned air at a rate not less than 0.02 cfm (.009 L/s) per square foot of horizontal area and one of the following is implemented:						
(1)	a concrete slab over 6 mil polyethylene sheeting. Or other Class I vapor retarder installed in accordance with Section 408.3 or Section 506 of the International Residential Code	**8**	0	0	☐		None
(2)	6 mil polyethylene sheeting, or other Class I vapor retarder installed in accordance with Section 408.3 or Section 506 of the International Residential Code	**N/A**					None
602.1.5	**602.1.5 Termite barrier.** Continuous physical foundation termite barrier provided: See Figure 6(3)				termite infest. prob.:		
(1)	In geographic areas that have moderate to heavy infestation potential in accordance with figure	**4**	0	0	☐		None

6	R			6(3), a no or low toxicity treatment is also installed.	4	0	0						
6	R		(2)	In geographic areas that have a very heavy infestation potential in accordance with figure 6(3), in addition a low toxicity bait and kill termite treatment plan is selected and implemented.	4	0	0	☐					
6	RF	602.1.6		**602.1.6 Termite-resistant materials.** In areas of termite infestation probability as defined by Figure 6(3), termite-resistant materials are used as follows:									
6	RF			See Figure 6(3)									
6	RF		(1)	In areas of slight to moderate termite infestation probability: for the foundation, all structural walls, floors, concealed roof spaces not accessible for inspection, exterior decks, and exterior claddings within the first 2 feet (610 mm) above the top of the foundation.	2	0	0	☐					None
6	RF		(2)	In areas of moderate to heavy termite infestation probability: for the foundation, all structural walls, floors, concealed roof spaces not accessible for inspection, exterior decks, and exterior claddings within the first 3 feet (914 mm) above the top of the foundation.	4	0	0	☐					
6	RF		(3)	In areas of very heavy termite infestation probability: for the foundation, all structural walls, floors, concealed roof spaces not accessible for inspection, exterior decks, and exterior claddings.	6	0	0	☐					
6 P	RF	602.1.7		**602.1.7 Moisture control measures**									
6 P	R	602.1.7.1		**602.1.7.1** Moisture control measures are in accordance with the following:									
6 P	R		(1)	Building materials with visible mold are not installed or are cleaned or encapsulated prior to concealment and closing.	2	2	0	☐					None
6 P	R		(2)	Insulation in cavities is dry in accordance with manufacturer's instructions when enclosed (e.g., with drywall).	Mandatory 2	2	0						None
6 P	R			NOTE: If "N/A" is selected, explain why in the assigned Notes area.									
6 P	R		(3)	The moisture content of lumber is sampled to ensure it does not exceed 19 percent prior to the surface and/or cavity enclosure.	4	4	0	☐					None
6 P	RF	602.1.7.2		**602.1.7.2** Moisture content of subfloor, substrate, or concrete slabs is in accordance with the appropriate industry standard for the finish flooring to be applied.	2	2	0	☐					OSB floors
6	R	602.1.7.3		**602.1.7.3** Building envelope assemblies are designed for moisture control based on documented hygrothermal simulation or field study analysis. Hygrothermal analysis is required to incorporate representative climatic conditions, interior conditions and include heating and cooling seasonal variation.	4	0	0	☐					None
6 P	R	602.1.8		**602.1.8 Water-resistive barrier.** Where required by the ICC, IRC, or IBC, a water-resistive barrier and/or drainage plane system is installed behind exterior veneer and/or siding.	Mandatory								None
6 P	R			NOTE: If "N/A" is selected, explain why in the assigned Notes area.									
6 P	R	602.1.9		**602.1.9 Flashing.** Flashing is provided as follows to minimize water entry into wall and roof assemblies and to direct water to exterior surfaces or exterior water-resistive barriers for drainage. Flashing details are provided in the construction documents and are in accordance with the fenestration manufacturer's instructions, the flashing manufacturer's instructions, or as detailed by a registered design professional.									
6 P	R		(1)	Flashing is installed at all of the following locations, as applicable:	Mandatory			☐					None
6 P	R		(a)	around exterior fenestrations, skylights, and doors									
6 P	R		(b)	at roof valleys									
6 P	R		(c)	at all building-to-deck, -balcony, -porch, and -stair intersections									
6 P	R		(d)	at roof-to-wall intersections, at roof-to-chimney intersections, at wall-to-chimney intersections, and at parapets									
6 P	R		(e)	at ends of and under masonry, wood, or metal copings and sills									
6 P	R		(f)	above projecting wood trim									
6 P	R		(g)	at built-in roof gutters, and									
6 P	R		(h)	drip edge is installed at eave and rake edges.									
6 P	R		(2)	All window and door head and jamb flashing is either self-adhered flashing complying with AAMA 711-13 or liquid applied flashing complying with AAMA 714-15 and installed in accordance with fenestration or flashing manufacturer's installation instructions.	2	2	0	☐					None
6 P	R		(3)	Pan flashing is installed at sills of all exterior windows and doors.	3	3	0	☐					None
6	R		(4)	Seamless, preformed kickout flashing, or prefabricated metal with soldered seams is provided at all roof-to-wall intersections. The type and thickness of the material used for roof flashing including but not limited kickout and step flashing is commensurate with the anticipated service life of the roofing material.	3	0	0	☐					None
6	R		(5)	A rainscreen wall design as follows is used for exterior wall assemblies		0	0						None
6	R		(a)	a system designed with minimum 1/4-inch air space exterior to the water-resistive barrier, vented to the exterior at top and bottom of the wall, and integrated with flashing details. OR	4								
6	R		(b)	a cladding material or a water-resistive barrier with enhanced drainage, meeting 75 percent drainage efficiency determined in accordance with ASTM E2273.	2								
6 P	R		(6)	Through-wall flashing is installed at transitions between wall cladding materials or wall construction types.	2	2	0	☐					None
6	R		(7)	Flashing is installed at expansion joints in stucco walls.	2	0	0	☐					None
6	RF	602.1.10		**602.1.10 Exterior doors.** Entries at exterior door assemblies, inclusive of side lights (if any), are covered by one of the following methods to protect the building from the effects of precipitation and solar radiation. Either a storm door or a projection factor of 0.375 minimum is provided. Eastern- and western-facing entries in Climate Zones 1, 2, and 3, as determined in accordance with Figure 6(1) or Appendix A, have either a storm door or a projection factor of 1.0 minimum, unless protected from direct solar radiation by other means (e.g., screen wall, vegetation)									
6	RF			This Project's Climate Zone: !!	2 per exterior door 6 Max	0	0						None
6	RF		(a)	installing a porch roof or awning									
6	RF		(b)	extending the roof overhang									
6	RF		(c)	recessing the exterior door									
6	RF		(d)	Installing a storm door									
6	RF			Note: The pedestrian door protected in a garage leading to living space does not qualify for points.									
6 P	RF	602.1.11		**602.1.11 Tile backing materials.** Tile backing materials installed under tiled surfaces in wet areas are in accordance with ASTM C1178, C1278, C1288, or C1325.	Mandatory								None
6	R	602.1.12		**602.1.12 Roof overhangs.** Roof overhangs, in accordance with Table 602.1.12, are provided over a minimum of 90 percent of exterior walls to protect the building envelope.	4	0	0	☐					None
6	R			See Table 602.1.12									
6 P	R	602.1.13		**602.1.13 Ice barrier.** In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier is installed in accordance with the ICC IRC or IBC at roof eaves of pitched roofs and extends a minimum of 24 inches (610 mm) inside the exterior wall line of the building.	Mandatory								None
6 P	RF	602.1.14		**602.1.14 Architectural features.** Architectural features that increase the potential for water intrusion are avoided:									
6 P	RF		(1)	All horizontal ledgers are sloped away to provide gravity drainage as appropriate for the application.	Mandatory 1	1	0						None
6 P	RF		(2)	No roof configurations that create horizontal valleys in roof design.	2	2	0	☐					None
6 P	RF		(3)	No recessed windows and architectural features that trap water on horizontal surfaces.	2	2	0	☐					None
6	F	602.1.15		**602.1.15 Kitchen and vanity cabinets.** All kitchen and vanity cabinets are certified in accordance with the ANSI/KCMA A161.1 performance standard or equivalent.	2	0	0	☐					None
6	F			NOTE: Identify what product was used in the assigned Notes area.									
6	RF	602.2		**602.2 Roof surfaces.** A minimum of 90 percent of roof surfaces, not used for roof penetrations and associated equipment, on-site renewable energy systems such as photovoltaics or solar thermal energy collectors, or rooftop decks, amenities and walkways, are constructed of one or more of the following:	3	0	0						
6	RF		(1)	products that are in accordance with the ENERGY STAR® cool roof certification or equivalent				☐					None
6	RF		(2)	a vegetated roof system				☐					None
6	RF		(3)	Minimum initial SRI of 78 for low-sloped roof (a slope less than 2:12) and a minimum initial SRI of 29 for a steep-sloped roof (a slope equal to or greater than 2:12). The SRI is calculated in accordance with ASTM E1980. Roof products are certified and labeled.				☐					None
6 P	F	602.3		**602.3 Roof water discharge.** A gutter and downspout system or splash blocks and effective grading are provided to carry water a minimum of 5 feet (1524 mm) away from perimeter foundation walls.	4	4	0	☐					None
6 P	RF	602.4		**602.4 Finished grade.**									
6 P	RF	602.4.1		**602.4.1** Finished grade at all sides of a building is sloped to provide a minimum of 6 inches (150 mm) of fall within 10 feet (3048 mm) of the edge of the building. Where lot lines, walls, slopes,				☐					None

6 P RF			or other physical barriers prohibit 6 inches (152 mm) of fall within 10 feet (3048 mm), the final grade is sloped away from the edge of the building at a minimum slope of 2 percent.	Mandatory						
6 RF	602.4.2		**602.4.2** The final grade is sloped away from the edge of the building at a minimum slope of 5 percent.	1	0	0	☐			None
6 P RF	602.4.3		**602.4.3** Water is directed to drains or swales to ensure drainage away from the structure.	1	1	0	☐			None
6 P RF	603 REUSED OR SALVAGED MATERIALS									
6	603.0		**603.0 Intent.** Practices that reuse or modify existing structures, salvage materials for other uses, or use salvaged materials in the building's construction are implemented.							
6 R	603.1		**603.1 Reuse of existing building.** Major elements or components of existing buildings and structures are reused, modified, or deconstructed for later use.							None
6 R			**(Points awarded for every 200 square feet (18.5 m^2) of floor area.)**	1	0	0				
6 R			NOTE: Describe materials used in the assigned Notes area. Materials, elements, or components awarded points under Section 603.1 shall not be awarded points under Section 603.2.	12 Max						
6 RF	603.2		**603.2 Salvaged materials.** Reclaimed and/or salvaged materials and components are used. The total material value and labor cost of salvaged materials is equal to or exceeds 1 percent of the total construction cost.							None
6 RF			**(Points awarded per 1% of salvaged materials used based on the total construction cost.)**	1	0	0				
6 RF			NOTE: Describe materials used in the assigned Notes area. Materials, elements, or components awarded points under Section 603.1 shall not be awarded points under Section 603.2.	9 Max						
6 RF	603.3		**603.3 Scrap materials.** Sorting and reuse of scrap building material is facilitated (e.g., a central storage area or dedicated bins are provided).	4	0	0	☐			None
6 RF			NOTE: Indicate in the assigned Notes area what salvage materials were sorted for reuse.							
6 P RF	604 RECYCLED-CONTENT BUILDING MATERIALS									
6 P RF	604.1		**604.1 Recycled content.** Building materials with recycled content are used for two minor and/or two major components of the building.				First Minor Comp.:			Steel
6 P RF			Enter material percent recycled content.							
6 P RF			See Table 604.1				Second Minor Comp.:			AL
6 P RF			NOTE: In the assigned Notes area, list materials used for minor and/or major building components.	per Table 604.1	3	0	First Major Comp.:			None
6 P RF							Second Major Comp.:			None
6 P RF	605 RECYCLED CONSTRUCTION WASTE									
6	605.0		**605.0 Intent.** Waste generated during construction is recycled.							
6 P R	605.1		**605.1 Hazardous waste.** The construction and waste management plan shall include information on the proper handling and disposal of hazardous waste. Hazardous waste is properly handled and disposed.	Mandatory			☐			None
6 RF	605.2		**605.2 Construction waste management plan.** A construction waste management plan is developed, posted at the jobsite, and implemented diverting, through reuse, salvage, recycling, or manufacturer reclamation, a minimum of 50 percent (by weight) of nonhazardous construction and demolition waste from disposal. For this practice, land clearing debris is not considered construction waste. Materials used as alternative daily cover are considered construction waste and do not count toward recycling or salvaging.				☐			None
6 RF			For buildings following the new construction path that also have a renovation component, the waste management plan includes the recycling of 95 percent of electronic waste components (such as printed circuit boards from computers, building automation systems, HVAC, fire and security control boards) by an E-Waste recycling facility.	6	0	0				
6 RF			**Exceptions:**							
6 RF		**(1)**	Waste materials generated from land clearing, soil and sub-grade excavation and vegetative debris shall not be in the calculations.							
6 RF		**(2)**	A recycling facility (traditional or E-Waste) offering material receipt documentation is not available within 50 miles of the jobsite.				☐			
6 RF	605.3		**605.3 On-site recycling.** On-site recycling measures following applicable regulations and codes are implemented, such as the following:	7	0	0	☐			None
6 RF		**(a)**	Materials are ground or otherwise safely applied on-site as soil amendment or fill. A minimum of 50 percent (by weight) of construction and land-clearing waste is diverted from landfill.							
6 RF		**(b)**	Alternative compliance methods approved by the Adopting Entity.							
6 RF		**(c)**	Compatible untreated biomass material (lumber, posts, beams, etc.) are set aside for combustion if a solid fuel-burning appliance per Section 901.2.1(2) will be available for on-site renewable energy.							
6 RF	605.4		**605.4 Recycled construction materials.** Construction materials (e.g., wood, cardboard, metals, drywall, plastic, asphalt roofing shingles, or concrete) are recycled offsite.	6 Max	0	0				
6 RF		**(1)**	a minimum of two types of materials are recycled	3						
6 RF		**(2)**	for each additional recycled material type	1						
6 RF		**(a)**	wood				☐			None
6 RF		**(b)**	cardboard				☐			
6 RF		**(c)**	metals				☐			
6 RF		**(d)**	drywall				☐			
6 RF		**(e)**	plastic				☐			
6 RF		**(f)**	asphalt roofing shingles				☐			
6 RF		**(g)**	concrete				☐			
6 RF		**(h)**	other				☐			None
6 RF		**(i)**	other				☐			None
6 RF			NOTE: List "other" types of materials recycled in the assigned Notes area.							
6 P RF	606 RENEWABLE MATERIALS									
6	606.0		**606.0 Intent.** Building materials derived from renewable resources are used.							
6 RF	606.1		**606.1 Biobased products.** The following biobased products are used:							None
6 RF		**(a)**	certified solid wood in accordance with Section 606.2							
6 RF		**(b)**	engineered wood							
6 RF		**(c)**	bamboo							
6 RF		**(d)**	cotton							
6 RF		**(e)**	cork		0	0				
6 RF		**(f)**	straw							
6 RF		**(g)**	natural fiber products made from crops (soy-based, corn-based)							
6 RF		**(h)**	other biobased materials with a minimum of 50 percent biobased content (by weight or volume)							
6 RF			Note: Please list "other biobased materials" used in the Notes field							
6 RF		**(1)**	Two types of biobased materials are used, each for more than 0.5 percent of the project's projected building material cost.	3						
6 RF		**(2)**	Two types of biobased materials are used, each for more than 1 percent of the project's projected building material cost.	6						
6 RF		**(3)**	For each additional biobased material used for more than 0.5 percent of the project's projected building material cost.	1 2 Max						
6 RF	606.2		**606.2 Wood-based products.** Wood or wood-based products are certified to the requirements of one of the following:							
6 RF		**(a)**	American Forest Foundation's *American Tree Farm System®* (ATFS)							
6 RF		**(b)**	Canadian Standards Association's *Sustainable Forest Management System Standards* (CSA Z809)							
6 RF		**(c)**	*Forest Stewardship Council* (FSC)							
6 RF		**(d)**	*Program for Endorsement of Forest Certification Systems* (PEFC)							
6 RF		**(e)**	*Sustainable Forestry Initiative ® Program (SFI)*							
6 RF		**(f)**	National Wood Flooring Association's Responsible Procurement Program (RPP)							
6 RF		**(g)**	other product programs mutually recognized by PEFC							
6 RF		**(h)**	A manufacturer's fiber procurement system that has been audited by an approved agency as compliant with the provisions of ASTM D7612 as a responsible or certified source. Government or tribal forestlands whose water protection programs have been evaluated by an approved agency as compliant with the responsible source designation of ASTM D7612 are exempt from auditing in the manufacturers' fiber procurement system.				Program(s):			
6 RF		**(1)**	A minimum of two responsible or certified wood-based products are used for minor components of the building.	3	0	0				None None
6 RF			Note: Please list products and components in the Notes fields							
6 RF		**(2)**	A minimum of two responsible or certified wood-based products are used in major components							None

6	RF			of the building.	4	0	0					None
6	RF			Note: Please list products and components in the Notes fields								
6	RF	606.3		**606.3 Manufacturing energy.** Materials manufactured using a minimum of 33 percent of the primary manufacturing process energy derived from (1) renewable sources, (2) combustible waste sources, or (3) renewable energy credits (RECs) are used for major components of the building. **(2 points awarded per material.)**	6 Max	0	0					None
6	RF			Note: Please list materials in the Notes field								
6	P RF	607 RECYCLING AND WASTE REDUCTION										
6	F	607.1		**607.1 Recycling and composting.** Recycling and composting by the occupant are facilitated by one or more of the following methods:								
6	F		(1)	A readily accessible space(s) for recyclable material containers is provided and identified on the floorplan of the house or dwelling unit or a readily accessible area(s) outside the living space is provided for recyclable material containers and identified on the site plan for the house or building. The area outside the living space shall accommodate recycling bin(s) for recyclable materials accepted in local recycling programs.	2	0	0	☐				None
6	F		(2)	A readily accessible space(s) for compostable material containers is provided and identified on the floorplan of the house or dwelling unit or a readily accessible area(s) outside the living space is provided for compostable material containers and identified on the site plan for the house or building. The area outside the living space shall accommodate composting container(s) for locally accepted materials, or, accommodate composting container(s) for on-site composting.	4	0	0	☐				None
6	F	607.2		**607.2 Food waste disposers.** A minimum of one food waste disposer is installed at the primary kitchen sink.	1	0	0	☐				None
6	P RF	608 RESOURCE-EFFICIENT MATERIALS										
6	RF	608.1		**608.1 Resource-efficient materials.** Products containing fewer materials are used to achieve the same end-use requirements as conventional products, including but not limited to:								None
6	RF		(1)	lighter, thinner brick with bed depth less than 3 inches and/or brick with coring of more that 25 percent	9 Max 3 per material	0	0					
6	RF		(2)	engineered wood or engineered steel products								
6	RF		(3)	roof or floor trusses								
6	RF			NOTE: In the assigned Notes area, describe the types of products that comply with 608.1.								
6	P RF	609 REGIONAL MATERIALS										
6	P RF	609.1		**609.1 Regional materials.** Regional materials are used for major and/or minor components of the building.	10 Max			# of major components:				
6	P RF		(1)	Major component	2 per each component	4	0					Brick & Concrete
6	P RF							# of minor components:				
6	P RF		(2)	Minor component	1 per each component							None
6	P RF			**For a component to comply with this practice, a minimum of 75 percent of all products in that component category must be sourced regionally, e.g., stone veneer category – 75 percent or more of the stone veneer on a project must be sourced regionally.**								
6	P RF			NOTE: In the assigned Notes areas, list major and minor materials used that comply with 609.1.								
6	P RF	610 LIFE CYCLE ASSESSMENT										
6		610.1		**610.1 Life cycle assessment.** A life cycle assessment (LCA) tool is used to select environmentally preferable products, assemblies, or, entire building designs. Points are awarded in accordance with Section 610.1.1 or 610.1.2. Only one method of analysis or tool may be utilized. The reference service life for the building is 60 years for any life cycle analysis tool. Results of the LCA are reported in the manual required in Section 1001.1 or 1002.1(1) of this Standard in terms of the environmental impacts listed in this practice and it is stated if operating energy was included in the LCA.								None
6				NOTE: Identify the LCA tool utilized and the person who completed the analysis.								
6	R	610.1.1		**610.1.1 Whole-building life cycle assessment.** A whole-building LCA is performed in conformance with ASTM E2921 using ISO14044 compliant life cycle assessment.								
6	R		(1)	Execute LCA at the whole building level through a comparative analysis between the final and reference building designs as set forth under Standard Practice, ASTM E2921. The assessment criteria includes the following environmental impact categories: **(a)** Primary energy use **(b)** Global warming potential **(c)** Acidification potential **(d)** Eutrophication potential **(e)** Ozone depletion potential **(f)** Smog potential	8	0	0	☐				None
6	R		(2)	Execute LCA on regulated loads throughout the building operations life cycle stage. Conduct simulated energy performance analyses in accordance with Section 702.2.1 ICC IECC analysis (IECC Section 405) in establishing the comparative performance of final versus reference building designs. Primary energy use savings and global warming potential avoidance from simulation analyses results are determined using energy supplier, utility, or EPA electricity generation and other fuels energy conversion factors and electricity generation and other fuels emission rates for the locality or Sub-Region in which the building is located	5	0	0	☐				None
6	R		(3)	Execute full LCA, including use-phase, through calculation of operating energy impacts (c) – (f) using local or regional emissions factors from energy supplier, utility, or EPA.	2	0	0	☐				None
6	R	610.1.2		**610.1.2 Life cycle assessment for a product or assembly.** An environmentally preferable product or assembly is selected for an application based upon the use of an LCA tool that incorporates data methods compliant with ISO 14044 or other recognized standards that compare the environmental impact of products or assemblies.	10 Max	0	0					
6	R	610.1.2.1		**610.1.2.1 Product LCA.** A product with improved environmental impact measures compared to another product(s) intended for the same use is selected. The environmental impact measures used in the assessment are selected from the following: **(a)** Primary energy use **(b)** Global warming potential **(c)** Acidification potential **(d)** Eutrophication potential **(e)** Ozone depletion potential **(f)** Smog potential **(Points are awarded for each product/system comparison where the selected product/system improved upon the environmental impact measures by an average of 15 percent.)** NOTE: List products/systems compared & impact measures considered in the assigned Notes area.	per Table 610.1.2.1 10 Max			# of comparisons with 4 measures:				None
								# of comparisons with 5 measures:				None
6	R	610.1.2.2		**610.1.2.2 Building assembly LCA.** A building assembly with improved environmental impact measures compared to an alternative assembly of the same function is selected. The full life cycle, from resource extraction to demolition and disposal (including but not limited to on-site construction, maintenance and replacement, material and product embodied acquisition, and process and transportation energy), is assessed. The assessment includes all structural elements, insulation, and wall coverings of the assembly. The assessment does not include electrical and mechanical equipment and controls, plumbing products, fire detection and alarm systems, elevators, and conveying systems. The following types of building assemblies are eligible for points under this practice: **(a)** exterior walls **(b)** roof/ceiling **(c)** interior walls or ceilings **(d)** intermediate floors The environmental impact measures used in the assessment are selected from the following: **(a)** Primary energy use **(b)** Global warming potential **(c)** Acidification potential **(d)** Eutrophication potential **(e)** Ozone depletion potential **(f)** Smog potential **(Points are awarded based on the number of types of building assemblies that improve upon environmental impact measures by an average of 15 percent.)**	per Table 610.1.2.2 10 Max			exterior walls:				None
								roof/ceiling:				None
								int. walls or ceilings:				None
								intermediate floors:				None

6	R			NOTE: List assemblies compared & impact measures considered in the assigned Notes area.							
6	R										
6 P	RF	611 PRODUCT DECLARATIONS									
6	F	611.1		**611.1 Product declarations.** A minimum of 10 different products installed in the building project, at the time of certificate of occupancy, comply with one of the following sub-sections. Declarations, reports, and assessments are submitted and contain documentation of the critical peer review by an independent third party, results from the review, the reviewer's name, company name, contact information, and date of the review.	**5**	0	0				
6	F	611.1.1		**611.1.1 Industry-wide declaration.** A Type III industry-wide environmental product declaration (EPD) is submitted for each product. Where the program operator explicitly recognizes the EPD as representative of the product group on a National level, it is considered industry-wide. In the case where an industry-wide EPD represents only a subset of an industry group, as opposed to being industry-wide, the manufacturer is required be explicitly recognized as a participant by the EPD program operator. All EPDs are required to be consistent with ISO Standards 14025 and 21930 with at least a cradle-to-gate scope. **(Each product complying with Section 611.1.1 shall be counted as one product for compliance with Section 611.1.)**				# of products:			None
6	F			NOTE: List products in the assigned Notes area.							
6	F	611.1.2		**611.1.2 Product Specific Declaration.** A product specific Type III EPD are submitted for each product. The product specific declaration shall be manufacturer specific for an individual product or product family. All Type III EPDs are required to be certified as complying, at a minimum, with the goal and scope for the cradle-to-gate requirements in accordance with ISO Standards 14025 and 21930. **(Each product complying with Section 611.1.2 shall be counted as two products for compliance with Section 611.1.)**				# of products (not effective number):			None
6	F			NOTE: List products in the assigned Notes area.							
6 P	RF	612 INNOVATIVE PRACTICES									
6	RF	612.1		**612.1 Manufacturer's environmental management system concepts.** Product manufacturer's operations and business practices include environmental management system concepts, and the production facility is registered to ISO 14001 or equivalent. The aggregate value of building products from registered ISO 14001 or equivalent production facilities is 1 percent or more of the estimated total building materials cost. **(1 point awarded per percent.)**	**10 Max**	0	0				None
6	RF			NOTE: In the assigned Notes area, list products that comply with manufacturers and ISO registrars.							
6	RF	612.2		**612.2 Sustainable products.** One or more of the following products are used for at least 30% of the floor or wall area of the entire dwelling unit or the sleeping unit, as applicable. Products are certified by a third-party agency accredited to ISO 17065.	**9 Max**	0	0				
6	RF		**(1)**	50% or more of carpet installed (by square feet) is certified to NSF 140 or equivalent.	**3**			☐			None
6	RF		**(2)**	50% or more of resilient flooring installed (by square feet) is certified to NSF 332 or equivalent.	**3**			☐			None
6	RF		**(3)**	50% or more of the insulation installed (by square feet) is certified to UL 2985 or equivalent.	**3**			☐			None
6	RF		**(4)**	50% or more of interior wall coverings installed (by square feet) is certified to NSF 342 or equivalent.	**3**			☐			None
6	RF		**(5)**	50% or more of the gypsum board installed (by square feet) is certified to UL 100 or equivalent.	**3**			☐			None
6	RF		**(6)**	50% or more of the door leafs installed (by number of door leafs) is certified to UL 102 or equivalent.	**3**			☐			None
6	RF		**(7)**	50% or more of the tile installed (by square feet) is certified to TCNA A138.1 Specifications for Sustainable Ceramic Tiles, Glass Tiles and Tile Installation Materials or equivalent.	**3**			☐			None
6 P	RF	612.3		**612.3 Universal design elements.** Dwelling incorporates one or more of the following universal design elements. Conventional industry construction tolerances are permitted.	**12 Max**	1	0				
6 P	RF		**(1)**	Any no-step entrance into the dwelling which (1) is accessible from a substantially level parking or drop-off area (no more than 2%) via an accessible path which has no individual change in elevation or other obstruction of more than 1-1/2 inches in height with the pitch not exceeding 1 in 12 and (2) provides a minimum 32-inch wide clearance into the dwelling.	**3**			☐			None
6 P	RF		**(2)**	Minimum 36-inch wide accessible route from the no-step entrance into at least one visiting room in the dwelling and into at least one full or half bathroom which has a minimum 32-inch clear door width and a 30-inch by 48-inch clear area inside the bathroom outside the door swing.	**3**			☐			None
6 P	RF		**(3)**	Minimum 36-inch wide accessible route from the no-step entrance into at least one bedroom which has a minimum 32-inch clear door width.	**3**			☐			None
6 P	R		**(4)**	Blocking or equivalent installed in the accessible bathroom walls for future installation of grab bars at water closet and bathing fixture, if applicable.	**1**			☐			None
6 P	RF		**(5)**	All interior and exterior door handles are levers rather than knobs.	**1**			☐			None
6 P	RF		**(6)**	All sink, lavatory and showering controls that comply with ICC A117.1.	**1**			☐			None
6 P	RF		**(7)**	Interior convenience Power receptacles, communication connections (for cable, phone, Ethernet, etc.) and switches are placed between 15" and 48" above the finished floor. Additional switches to control devices and systems (such as alarms, home theaters and other equipment) not required by the local building code may be installed as desired.	**1**			☐			None
6 P	RF		**(8)**	All light switches are rocker-type switches or other similar switches that can be operated by pressing them (with assistive devices). Toggle-type switches may not be used.	**1**			☐			None
6 P	RF		**(9)**	Any of the following can be controlled with a (wireless) mobile device such as a smartphone, tablet or laptop computer: HVAC, lighting, alarm system or door locks	**1 per system [5 max]**						None
6 P	RF	613 RESILIENT CONSTRUCTION									
6 P	RF	613.1		**613.1 Intent.** Design and construction practices developed by a licensed design professional or equivalent are implemented that enhance the resilience and durability of the structure (above building code minimum design loads) so the structure can better withstand forces generated by; flooding, snow, wind or seismic activity (as applicable) and reduce the potential for the loss of life and property.		2	0				seee structural plans
6 P	RF		**(a)**	**Minimum structural requirements (base design).** The building is designed and constructed in compliance with structural requirements in the IBC or IRC as applicable.	**2**						
6 P	RF		**(b)**	**Enhanced resilience – 10% above base design.** Design and construction practices are implemented that enhance the resilience and durability of the structure by designing and building to forces generated by; flooding, snow, wind or seismic (as applicable) that are 10% higher than the base design.	**3**						
6 P	RF		**(c)**	**Enhanced resilience – 20% above base design.**	**5**						
6 P	RF		**(d)**	**Enhanced resilience – 30% above base design.**	**10**						
6 P	RF		**(e)**	**Enhanced resilience – 40% above base design.**	**12**						
6 P	RF		**(f)**	**Enhanced resilience – 50% above base design.**	**15**						

701 MINIMUM ENERGY EFFICIENCY REQUIREMENTS

701.1 **701.1 Mandatory requirements.** The building shall comply with Section 702 (Performance Path), Section 703 (Prescriptive Path), or Section 704 (ERI Target Path). Items listed as "mandatory" in Section 701.4 apply to all Paths. Unless otherwise noted, buildings in the Tropical Climate Zone shall comply with Climate Zone 1 requirements.

Select Path:

Please indicate energy modeler's professional credential and, in the notes field, their name. When selecting "Other," enter professional credentials (e.g., engineer, architect) within the notes field.

Modeler's Credential:

Performance Point

701.1.1 **701.1.1 Minimum Performance Path requirements.** A building complying with § 702 shall include a minimum of two practices from § 705, or a minimum of one practice from § 705 and a minimum of one practice from § 706.

None

701.1.2 **701.1.2 Minimum Prescriptive Path requirements.** A building complying with § 703 shall obtain a minimum of 30 points from § 703 and shall include a minimum of two practices from § 705, or a minimum of one practice from § 705 and a minimum of one practice from § 706.

None

701.1.3 **701.1.3 ERI Target Path requirements.** A building complying with § 704 shall obtain a minimum of 30 points from § 704 and shall include a minimum of two practices from § 705, or a minimum of one practice from § 705 and a minimum of one practice from § 706.

None

701.1.4 **701.1.4 Alternative bronze and silver level compliance**. As an alternative, any building that qualifies as an ENERGY STAR Version 3.0 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev. 03 building or demonstrates compliance with the 2018 IECC or Chapter 11 of the 2018 IRC achieves the bronze level for Chapter 7. As an alternative, any building that qualifies as an ENERGY STAR Version 3.1 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev. 03 (with the baseline at ASHRAE 90.1-2010) building achieves the silver level for Chapter 7. As an alternative in the Tropical Climate Zone, any building that meets all of the requirements in IECC Section R401.2.1 (Tropical Zone) achieves the silver level for Chapter 7. The buildings achieving compliance under Section 701.1.4 are not eligible for achieving a rating level above silver.

Alternative:

Option:

0 0

None

701.1.6 **701.1.6 Alternative gold level compliance for tropical zones**. One- or two-family dwelling in the tropical zone at an elevation less than 2,400 feet (731.5 m) above sea level that complies with the following shall achieve the gold level for chapter 7:

(1)	The residence complies with IECC Tropical Zone than section R401.2.1.	N/A	None
(2)	The residence includes a minimum of 2 kW of PV and a minimum of 6 kWh of battery storage.	N/A	None
(3)	Any air conditioning has a minimum of 18 SEER.	N/A	None
(4)	Solar, wind or other renewable energy source supplies not less than 90 percent of the energy for service water heating.	N/A	None
(5)	Glazing in conditioned spaces has a solar heat gain coefficient of less than or equal to 0.25, or has an overhang with a projection factor equal to or greater than 0.30.	N/A	None
(6)	The exterior roof/ceiling complies with at least two of the following:		
(a)	Minimum roof reflectance and emittance in IECC Table C402.3	N/A	None
(b)	Roof or ceiling has insulation with an R-value of R-15 or greater	N/A	None
(c)	Includes a radiant barrier	N/A	None
(7)	Walls comply with at least one of the following:		
(a)	Walls have an overhang with a projection factor equal to or greater than 0.30	N/A	None
(b)	Walls have insulation with an R-value of R-13 or greater	N/A	None
(c)	Walls have a solar reflectance of 0.64	N/A	None
(8)	A ceiling fan is provided for bedrooms and the largest space that is not used as a bedroom; alternately a whole house fan is provided.	N/A	None
(9)	Wiring sufficient for a Level 2 (208/240V 40-80 amp) electric vehicle charging station is installed on the building site.	N/A	None

701.2 **701.2 Emerald level points.** The Performance Path (Section 702) or the ERI Target Path (Section 704) shall be used to achieve the emerald level.

Emerald Not Available

701.3 **701.3 Adopting Entity review.** A review by the Adopting Entity or designated third party shall be conducted to verify design and compliance with Chapter 7.

NOTE: List the reviewer in the assigned Notes field.

Performance Point

701.4 **701.4 Mandatory practices.**

701.4.1 **701.4.1 HVAC systems.**

701.4.1.1 **701.4.1.1 HVAC system sizing.** Space heating and cooling system is sized according to heating and cooling loads calculated using ACCA Manual J, or equivalent. Equipment is selected using ACCA Manual S or equivalent.

Mandatory

None

701.4.1.2 **701.4.1.2 Radiant and hydronic space heating.** Where installed as a primary heat source in the building, radiant or hydronic space heating system is designed, installed, and documented, using industry-approved guidelines and standards (e.g., ACCA Manual J, AHRI I=B=R, ACCA 5 QI-2010, or an accredited design professional's and manufacturer's recommendations).

Mandatory

None

701.4.2 **701.4.2 Duct systems.**

701.4.2.1 **701.4.2.1 Duct air sealing.** Ducts are air sealed. All duct sealing materials are in conformance with UL 181A or UL 181B specifications and are installed in accordance with manufacturer's instructions.

Mandatory

None

701.4.2.2 **701.4.2.2 Ducts and Plenums.** Building framing cavities are not used as ducts or plenums.

Mandatory

None

701.4.2.3 **701.4.2.3 Duct system sizing.** Duct system is sized and designed in accordance with ACCA Manual D or equivalent.

Mandatory

None

701.4.3 **701.4.3 Insulation and air sealing.**

701.4.3.1 **701.4.3.1 Building Thermal Envelope Air Sealing.** The building thermal envelope is durably sealed to limit infiltration. The sealing methods between dissimilar materials allow for differential expansion and contraction. The following are caulked, gasketed, weather-stripped or otherwise sealed with an air barrier material, suitable film, or solid material:

701.4.3.3 Exception:

None

(a)	All joints, seams and penetrations.	Mandatory	None
(b)	Site-built windows, doors, and skylights.		None
(c)	Openings between window and door assemblies and their respective jambs and framing.		None
(d)	Utility penetrations.		None
(e)	Dropped ceilings or chases adjacent to the thermal envelope.		None
(f)	Knee walls.		None
(g)	Walls, ceilings, and floors separating conditioned spaces from unconditioned.		None
(h)	Behind tubs and showers on exterior walls.		None
(i)	Common walls between dwelling units or sleeping units.		None
(j)	Attic access openings.		None
(k)	Joints of framing members at rim joists.		None
(l)	Top and bottom plates.		None
(m)	Other sources of infiltration.		None

701.4.3.2 **701.4.3.2 Air barrier, air sealing, building envelope testing, and insulation.** Building envelope air barrier, air sealing envelope tightness, and insulation installation is verified to be in accordance with this Section and Section 701.4.3.2.1. Insulation installation other than Grade 1 is not permitted.

Mandatory

ACH50:

ELR:

(1)	**Testing.** Building envelope tightness is tested. Testing is conducted in accordance with ASTM E-779 using a blower door at a test pressure of 1.04 psf (50 Pa). Testing is conducted after rough-in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances. Testing is conducted under the following conditions:		None
(a)	Exterior windows and doors, fireplace and stove doors are closed, but not sealed;		None
(b)	Dampers are closed, but not sealed, including exhaust, intake, makeup air, backdraft and flue dampers;		None
(c)	Interior doors are open;		None
(d)	Exterior openings for continuous ventilation systems and heat recovery ventilators are closed and sealed;		None
(e)	Heating and cooling systems are turned off;		None
(f)	HVAC duct terminations are not sealed; and		None
(g)	Supply and return registers are not sealed.		None
	Multifamily Building Note: Testing by dwelling units, sleeping units, groups of dwelling units, groups of sleeping units, or the building as a whole is acceptable.		None
(2)	**Visual inspection.** The air barrier and insulation items listed in Table 701.4.3.2(2) are field verified by visual inspection. See Table 701.4.3.2(2)		None

701.4.3.2.1 **701.4.3.2.1 Grade I insulation installations.** Field-installed insulation products to ceilings, walls,

7 P R			floors, band joists, rim joists, conditioned attics, basements, and crawlspaces, except as specifically noted, are verified as Grade I by a third-party are in accordance with the following:	Mandatory						
7 P R		(1)	Inspection is conducted before insulation is covered.							Grade 1 Insulation is mandatory for the NGBS
7 P R		(2)	Air-permeable insulation is enclosed on all six sides and is in substantial contact with the sheathing material on one or more sides (interior or exterior) of the cavity. Air permeable insulation in ceilings is not required to be enclosed when the insulation is installed in substantial contact with the surfaces it is intended to insulate.							None
7 P R		(3)	Cavity insulation uniformly fills each cavity side-to-side and top-to-bottom, without substantial gaps or voids around obstructions (such as blocking or bridging).							None
7 P R		(4)	Cavity insulation compression or incomplete fill amounts to 2 percent or less, presuming the compressed or incomplete areas are a minimum of 70 percent of the intended fill thickness; occasional small gaps are acceptable.							None
7 P R		(5)	Exterior rigid insulation has substantial contact with the structural framing members or sheathing materials and is tightly fitted at joints.							None
7 P R		(6)	Cavity insulation is split, installed, and/or fitted tightly around wiring and other services.							None
7 P R		(7)	Exterior sheathing is not visible from the interior through gaps in the cavity insulation.							None
7 P R		(8)	Faced batt insulation is permitted to have side-stapled tabs, provided the tabs are stapled neatly with no buckling, and provided the batt is compressed only at the edges of each cavity, to the depth of the tab itself.							None
7 P R		(9)	Where properly installed, ICFs, SIPs, and other wall systems that provide integral insulation are deemed in compliance with this section.							None
7 P R	701.4.3.3		**701.4.3.3 Multifamily air leakage alternative.** Multifamily buildings four or more stories in height and in compliance with IECC section C402.5 (Air leakage-thermal envelope) are deemed to comply with Sections 701.4.3.1 and 701.4.3.2.				See 701.4.3.1			None
7 P R	701.4.3.4		**701.4.3.4 Fenestration air leakage.** Windows, skylights and sliding glass doors have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m2), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m2), when tested in accordance with NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled. For site-built fenestration, a test report by an accredited, independent laboratory verifying compliance with the applicable infiltration rate shall be submitted to demonstrate compliance with this practice. This practice does not apply to field-fabricated fenestration products. **Exception:** For Tropical Zones Only, Jalousie windows are permitted to be used as a conditioned space boundary and shall have an air infiltration rate of not more than 1.3 cfm per square foot.	Mandatory			☐			None
7 P RF	701.4.3.5		**701.4.3.5 Lighting in building thermal envelope.** Luminaires installed in the building thermal envelope which penetrate the air barrier are sealed to limit air leakage between conditioned and unconditioned spaces. All luminaires installed in the building thermal envelope which penetrate the air barrier are IC-rated and labeled as meeting ASTM E283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity. All luminaires installed in the building thermal envelope which penetrate the air barrier are sealed with a gasket or caulk between the housing and the interior of the wall or ceiling covering.	Mandatory						None
7 P RF	701.4.4		**701.4.4 High-efficacy lighting.** Lighting efficacy in dwelling units or sleeping units is in accordance with one of the following:	Mandatory						
7 P RF		(1)	A minimum of 75 percent of the total hard-wired lighting fixtures or the bulbs in those fixtures qualify as high efficacy or equivalent				☐			None
7 P RF		(2)	Lighting power density, measured in watts/square foot, is 1.1 or less.				☐			None
7 P R	701.4.5		**701.4.5 Boiler piping.** Boiler piping in unconditioned space supplying and returning heated water or steam is insulated.	N/A			☐			None
7 P RF	702 PERFORMANCE PATH									
7	702.1		**702.1 Point allocation.** Points from Section 702 (Performance Path) shall not be combined with points from Section 703 (Prescriptive Path) or Section 704 (ERI Target Path).							
7 P F	702.2		**702.2 Energy performance levels.**							
7 P F	702.2.1		**702.2.1 ICC IECC analysis.** Energy efficiency features are implemented to achieve energy cost or source energy performance that meets the ICC IECC. A documented analysis using software in accordance with ICC IECC, Section R405, or ICC IECC Section C407.2 through C407.5, applied as defined in the ICC IECC, is required.	N/A			☐			None
7 F	702.2.2		**702.2.2 Energy performance analysis.** Energy savings levels above the ICC IECC are determined through an analysis that includes improvements in building envelope, air infiltration, heating system efficiencies, cooling system efficiencies, duct sealing, water heating system efficiencies, lighting, appliances, and on-site renewable energy. Points are assigned using the following formula: **Points = 30 + (percent above NGBS Reference Home) * 2** Multifamily Building Note: Modeling is completed building-wide using one of the following methods: whole building energy modeling, a unit-by-unit approach, or a building average of a unit-by-unit approach.	Points per formula	0	0	Percent above NGBS Reference Home:			None
7 F	702.2.3		**702.2.3 Tropical standard reference design.** For the Tropical Climate Zone, the standard reference design shall use the specifications in IECC Section R401.2.1 (Tropical Zone).							None
7 P RF	703 PRESCRIPTIVE PATH									
7 P F	703.1		**703.1 Mandatory practices.**	30	0	0				
7 P F	703.1.1		**703.1.1 Building thermal envelope compliance.** The building thermal envelope is in compliance with Section 703.1.1.1 or 703.1.1.2. Exception: Section 703.1.1 is not required for Tropical Climate Zone.	N/A			☐			None
7 P F	703.1.1.1		**703.1.1.1 Maximum UA and SHGC.** For IECC residential buildings, the total building UA is less than or equal to the total maximum UA as computed by ICC IECC Section R402.1.5. The SHGC requirements for fenestration in Table R402.1.2 are also met. For IECC commercial buildings, the total UA is less than or equal to the sum of the UA for ICC IECC Tables C402.1.4 and C402.4, including the U-factor times the area and C-factor or F-factor times the perimeter. The SHGC requirements for fenestration in Table C402.4 are also met. The total UA proposed and baseline calculations are documented. REScheck or COMcheck is deemed to provide UA calculation documentation.							
7 P F	703.1.1.2		**703.1.1.2 Prescriptive R-values and fenestration requirements**. The building thermal envelope is in accordance with the insulation and fenestration requirements of ICC IECC Table R402.1.2 or Tables C402.1.3. The fenestration U-factors and SHGC's are in accordance with Table 703.2.5.1 or ICC IECC Table C402.4.							
7 P F	703.1.2		**703.1.2 Building envelope leakage.** The building thermal envelope is in accordance with ICC IECC R402.4.1.2 or C402.5 as applicable. Exception: Section 703.1.2 is not required for Tropical Climate Zone	N/A			☐			None
7 P RF	703.1.3		**703.1.3 Duct Testing.** The duct system is in accordance with ICC IECC R403.3.2 through R403.3.5 as applicable.	N/A			Rough-In Test: Postconstruction Test:			None
7 RF	703.2		**703.2 Building envelope**							
7 F	703.2.1		**703.2.1 UA improvement.** The total building thermal envelope UA is less than or equal to the baseline total UA resulting from the U-factors provided in Table 703.2.1(a) or ICC IECC Tables C402.1.4 and C402.4, as applicable. Where insulation is used to achieve the UA improvement, the insulation installation is in accordance with Grade 1 meeting Section 701.4.3.2.1 as verified by a third-party. Total UA is documented using a RESCheck, COMCheck, or equivalent report to verify the baseline and the UA improvement. See Table 703.2.1(a)	Per Table 703.2.1(b)	0	0	☐ UA Improvement:			None
7 RF	703.2.2		**703.2.2 Mass walls.** More than 75 percent of the above-grade exterior opaque wall area of the building is mass walls.	Per Table 703.2.2	0	0	Mass thickness:			None
7 RF	703.2.3		**703.2.3** A radiant barrier with an emittance of 0.05 or less is used in the attic. The product is tested in accordance with ASTM C1371 and installed in accordance with the manufacturer's instructions.	0	0	0	☐			None
7 RF	703.2.4		**703.2.4 Building envelope leakage**. The maximum building envelope leakage rate is in accordance with Table 703.2.4a or Table 703.2.4b and whole building ventilation is provided in accordance with Section 902.2.1.	Per Table 703.2.4a or 703.2.4b	0	0	Air leakage from 701.4.3.2 or 705.6.2.1: 0.00			None
7 RF	703.2.5		**703.2.5 Fenestration**							
7 RF	703.2.5.1		**703.2.5.1** NFRC-certified (or equivalent) U-factor and SHGC of windows, exterior doors, skylights, and tubular daylighting devices (TDDs) on an area-weighted average basis do not exceed the values in Table 703.2.5.1. Area weighted averages are calculated separately for the							None

7	RF			categories of 1) windows and exterior doors and 2) skylights and tubular daylighting devices (TDDs). Decorative fenestration elements with a combined total maximum area of 15 square feet (1.39 m2) or 10 percent of the total glazing area, whichever is less, are not required to comply with this practice.	N/A						
7	RF			See Table 703.2.5.1							
7	RF	**703.2.5.1.1**		**703.2.5.1.1 Dynamic glazing.** Dynamic glazing is permitted to satisfy the SHGC requirements of Table 703.2.5.1 provided the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4 and the dynamic glazing is automatically controlled to modulate the amount of solar gain into the space in multiple steps. Fenestration with dynamic glazing is considered separately from other fenestration and area-weighted averaging with fenestration that does not use dynamic glazing is not permitted. Dynamic glazing is not required to be automatically controlled or comply with minimum SHGC ratio when both the lower and higher labeled SHGC already comply with the requirements of Table 703.2.5.1.							None
7	RF	**703.2.5.2**		**703.2.5.2** The NFRC-certified (or equivalent) U-factor and SHGC of windows, exterior doors, skylights, and tubular daylighting devices (TDDs) are in accordance with Table 703.2.5.2(a), (b), or (c). Decorative fenestration elements with a combined total maximum area of 15 square feet (1.39 m^2) or 10 percent of the total glazing area, whichever is less, are not required to comply with this practice.	Per Table 703.2.5.2(a) or 703.2.5.2(b) or 703.2.5.2(c)	0	0				None
7	RF		**(a)**	Table 703.2.5.2(a)	**0**						
7	RF		**(b)**	Table 703.2.5.2(b)	**0**						
7	RF		**(c)**	Table 703.2.5.2(c)	**0**						
7	RF	**703.2.5.2.1**		**703.2.5.2.1 Dynamic glazing.** Dynamic glazing is permitted to satisfy the SHGC requirements of Tables 703.2.5.2(a), 703.2.5.2(b), and 703.2.5.2(c) provided the ratio of the higher to lower labeled SHGC is greater than or equal to 2.4, and the dynamic glazing is automatically controlled to modulate the amount of solar gain into the space in multiple steps. Fenestration with dynamic glazing is considered separately from other fenestration, and area-weighted averaging with fenestration that does not use dynamic glazing is not permitted. Dynamic glazing is not required to be automatically controlled or comply with minimum SHGC ratio when both the lower and higher labeled SHGC already comply with the requirements of Tables 703.2.5.2(a), 703.2.5.2(b), and 703.2.5.2(c).							None
7	P RF	**703.3**		**HVAC equipment efficiency**							
7	P RF	**703.3.0**		**703.3.0 Multiple heating and cooling systems.** For multiple heating or cooling systems in one home, practices 703.3.1 through 703.3.6 apply to the system that supplies 80% or more of the total installed heating or cooling capacity. Where multiple systems each serve less than 80% of the total installed heating or cooling capacity, points under Sections 703.3.1 through 703.3.6 are awarded either for the system eligible for the fewest points or the weighted average of the systems. The weighted average shall be calculated in accordance with the following equation and be based upon the efficiency and capacity of the equipment as selected in accordance with ACCA Manual S with it loads calculated in accordance with ACCA Manual J.				multiple heating sys.?			None
7	P RF							multiple cooling sys.?			None
7	P RF			Weighted Average = $[(E_{unit\,1}*C_{unit\,1})+(E_{unit\,2}*C_{unit\,2})+\ldots+(E_{unit\,n}*C_{unit\,n})] / (C_{unit\,1}+C_{unit\,2}+\ldots+C_{unit\,n})$							
7	P RF			where:							
7	P RF			E = Rated AHRI efficiency for unit							
7	P RF			C = Rated heating or cooling capacity for unit							
7	P RF			*n* = Unit count							
7	RF	**703.3.1**		**703.3.1** Combination space heating and water heating system (combo system) is installed using either a coil from the water heater connected to an air handler to provide heat for the building, dwelling unit or sleeping unit, or a space heating boiler using an indirect-fired water heater. Devices have a minimum combined annual efficiency of 0.80 and a minimum water heating recovery efficiency of 0.87.	**4**	0	0	☐			None
7	RF	**703.3.2**		**703.3.2** Furnace and/or boiler efficiency is in accordance with one of the following:							
7	RF		**(1)**	Gas and propane heaters:		0	0	Min. or Average AFUE:			None
7	RF			≥90% AFUE	**0**						
7	RF			≥92% AFUE	**0**						
7	RF			≥94% AFUE	**0**						
7	RF			≥96% AFUE	**0**						
7	RF			≥98% AFUE	**0**						
7	RF		**(2)**	Oil furnace:		0	0	Min. or Average AFUE:			None
7	RF			≥85% AFUE	**0**						
7	RF			≥90% AFUE	**0**						
7	RF		**(3)**	Gas boiler:		0	0	Min. or Average AFUE:			None
7	RF			≥85% AFUE	**0**						
7	RF			≥90% AFUE	**0**						
7	RF			≥94% AFUE	**0**						
7	RF			≥96% AFUE	**0**						
7	RF		**(4)**	Oil boiler:		0	0	Min. or Average AFUE:			None
7	RF			≥85% AFUE	**0**						
7	RF			≥90% AFUE	**0**						
7	RF	**703.3.3**		**703.3.3** Heat pump heating efficiency is in accordance with Table 703.3.3(1) or Table 703.3.3(2) or Table 703.3.3(3). Refrigerant charge is verified for compliance with manufacturer's instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010.							
7	RF		**(1)**	Electric Heat Pump Heating		0	0	Min. or Average HSPF:			None
7	RF			≥8.5 HSPF	**0**						
7	RF			≥9.0 HSPF	**0**						
7	RF			≥9.5 HSPF	**0**						
7	RF			≥10.0 HSPF	**0**						
7	RF			≥12.0 HSPF	**0**			Min. or Average HSPF:			
7	RF		**(2)**	Electric Heat Pump Heating for Multifamily Buildings Four or More Stories in Height	**0**	0	0				None
7	RF							Min. or Average COP:			
7	RF		**(3)**	Gas Engine-Driven Heat Pump Heating (≥1.3 COP at 47°F)	**0**	0	0				None
7	RF	**703.3.4**		**703.3.4** Cooling efficiency is in accordance with Table 703.3.4(1) or Table 703.3.4(2). Refrigerant charge is verified for compliance with manufacturer's instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010.							
7	RF		**(1)**	Electric Air Conditioner and Heat Pump Cooling		0	0	Min. or Average SEER:			None
7	RF			≥15 SEER	**0**						
7	RF			≥17 SEER	**0**						
7	RF			≥19 SEER	**0**						
7	RF			≥21 SEER	**0**						
7	RF			≥25 SEER	**0**						
7	RF		**(*)**	Tropical Climate Zone: None of the occupied space is air conditioned and ceiling fans are provided for bedrooms and the largest space which is not used as a bedroom.	**20**	0	0	☐			None
7	RF							Min. or Average COP:			
7	RF		**(2)**	Gas Engine-Driven Heat Pump Cooling (≥1.2 COP at 95°F)	**0**	0	0				None
7	RF	**703.3.5**		**703.3.5** Water source cooling and heating efficiency is in accordance with Table 703.3.5. Refrigerant charge is verified for compliance with manufacturer's instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010.	**0**	0	0	☐			None
7	RF			≥15 SEER, ≥4.0 COP							
7	RF	**703.3.6**		**703.3.6** Ground source heat pump is installed by a Certified Geothermal Service Contractor in accordance with Table 703.3.6. Refrigerant charge is verified for compliance with manufacturer's instructions utilizing a method in Section 4.3 of ACCA 5 QI-2010.		0	0	Min. or Average EER:			None
7	RF			≥16 EER, ≥3.6 COP	**0**						
7	RF			≥24 EER, ≥4.3 COP	**0**						
7	RF			≥28 EER, ≥4.8 COP	**0**						
7	F	**703.3.7**		**703.3.7** ENERGY STAR, or equivalent, ceiling fans are installed.	**1**	0	0	☐			None
7	F			**(Points awarded per building.)**				# of fans:			
7	F			**Note for Tropical Climate Zone and Climate Zones 2B, 3B, and 4B: points awarded per fan where AC is not installed in the dwelling unit or sleeping unit (Max 8 points), and where points awarded in Section 703.3.8 for these specific climate zones, points shall not be awarded in Section 703.3.7**							
7	F			NOTE: For multi-unit buildings, each dwelling unit must comply to claim this point.							
7	RF	**703.3.8**		**703.3.8** Whole-building or whole-dwelling unit or whole-sleeping unit fan(s) with insulated louvers and a sealed enclosure is installed.	**0**	0	0	☐			None
7	RF			**(Points awarded per building.)**							
7				NOTE: For multi-unit buildings, each dwelling unit must have compliant whole-dwelling unit fans installed to claim these points.							
7	RF	**703.4**		**703.4 Duct Systems**							
7	RF	**703.4.1**		**703.4.1** All space heating is provided by a system(s) that does not include air ducts.		0	0	☐			None

7					(No points awarded for multifamily buildings four or more stories in height.)								
7	RF	703.4.2			**703.4.2** All space cooling is provided by a system(s) that does not include air ducts.	**0**	0	0	☐			None
7					(No points awarded for multifamily buildings four or more stories in height.)							
7	R	703.4.3			**703.4.3** Ductwork is in accordance with all of the following:	**0**	0	0				
7	R		(1)		Building cavities are not used as return ductwork.				☐			None
7	R		(2)		Heating and cooling ducts and mechanical equipment are installed within the conditioned building space.				☐			None
7	R		(3)		Ductwork is not installed in exterior walls.				☐			None
7					(No points awarded for multifamily buildings four or more stories in height.)							
7	F	703.4.4			**703.4.4 Duct Leakage.** The entire central HVAC duct system, including air handlers and register boots, is tested by a third party for total leakage at a pressure differential of 0.1 inches w.g. (25 Pa) and maximum air leakage is equal to or less than 6 percent of the system design flow rate or 4 cubic feet per minute per 100 square feet of conditioned floor area.		0	0				None
7	F				**(Points not awarded if points are taken under Section 705.6.2.3)**							
7	F		(1)		ductwork entirely outside the building's thermal envelope	**0**						
7	F		(2)		ductwork entirely inside the building's thermal envelope	**0**						
7	F		(3)		ductwork inside and outside the building's thermal envelope	**0**						
7	RF	703.5			**703.5 Water heating system**							
7	RF	703.5.1			**703.5.1** Water heater Uniform Energy Factor (UEF) is in accordance with the following:				type:			None
7	RF				Where multiple systems are used, points awarded based on the system with the lowest efficiency.							
7	RF				Water heater design is based on only 1 (one) water heater per dwelling unit, based on approved methods from IPC or ASPE or manufacturer specifications.							
7	RF				All table values are based on water heaters with medium water draws as defined by the US DOE text procedures (55 gallons per day).							
7	RF								type:			
7	RF		(1)		Gas water heating							
7	RF			(a)	Storage Water Heater, Rated Storage Volume > 20 Gallons and ≤ 55 Gallons, Medium Water Draw		0	0	efficiency:			
7	RF				UEF: 0.65 to <0.78	**0**						
7	RF				UEF: ≥0.78	**0**						
7	RF			(b)	Storage Water Heater, Rated Storage Volume > 55 Gallons and ≤ 100 Gallons, Medium Water Draw	**1**	0	0				
7	RF			(c)	Storage Water Heater with Input Rate Greater than 75,000 Btu/h (Commercial)		0	0				
7	RF				Thermal Efficiency: 0.90 to < 0.95	**0**						
7	RF				Thermal Efficiency: ≥0.95	**0**						
7	RF			(d)	Storage Water Heater with Input Rate Greater than 75,000 Btu/H (Commercial), In Buildings with High-Capacity Service Water-Heating Systems (1,000,000 Btu/h or Greater)		0	0				
7	RF				Thermal Efficiency: 0.92 to < 0.95	**1**						
7	RF				Thermal Efficiency: ≥0.95	**0**						
7	RF			(e)	Instantaneous Water Heater, Rated Storage Volume < 2 Gallons and Input Rate of > 50,000 Btu/h, Medium Water Draw		0	0				
7	RF				UEF: 0.89 to < 0.94	**0**						
7	RF				UEF: ≥0.94	**0**			type:			
7	RF		(2)		Electric water heating							
7	RF			(a)	Storage Water Heater, Rated Storage Volume ≥ 20 Gallons and ≤ 55 Gallons, Medium Water Draw		0	0	efficiency:			
7	RF				UEF: 0.94 to <1.0	**1**						
7	RF				UEF: 1.0 to <1.5	**0**						
7	RF				UEF: 1.5 to <2.0	**0**						
7	RF				UEF: 2.0 to <2.2	**0**						
7	RF				UEF: 2.2 to <2.5	**0**						
7	RF				UEF: 2.5 to <3.0	**0**						
7	RF				UEF: ≥3.0	**0**						
7	RF			(b)	Storage Water Heater, Rated Storage Volume ≥ 55 Gallons and ≤ 120 Gallons, Medium Water Draw		0	0				
7	RF				UEF: 2.2 to <2.5	**0**						
7	RF				UEF: 2.5 to <3.0	**0**						
7	RF				UEF: 3.0 to <3.5	**0**						
7	RF				UEF: ≥3.5	**0**						
7	RF			(c)	Electric Tabletop Water Heating (Tabletop Water Heater, Rated Storage Volume ≥ 20 Gallons and ≤ 120 Gallons, Medium Water Draw)	**1**	0	0				
7	RF			(d)	Electric Instantaneous Water Heating (Instantaneous Electric Water Heater, Rated Storage Volume < 2 Gallons, Medium Water Draw)	**1**	0	0				
7	RF			(e)	Electric Grid Enabled Water Heating (Grid Enabled Storage Water Heater, Rated Storage Volume ≥ 75 Gallons, Medium Water Draw)	**2**	0	0	efficiency:			
7	RF		(3)		Oil water heating (Oil water heating, < 50 gallons, Medium water draw)	**1**	0	0				
7	RF	703.5.2			**703.5.2** Desuperheater is installed by a qualified installer or is pre-installed in the factory.	**0**	0	0	☐			None
7	RF	703.5.3			**703.5.3** Drain-water heat recovery system is installed.	**2**	0	0	☐			None
7	RF				**(Points awarded per building.)**							
7	RF	703.5.4			**703.5.4** Indirect-fired water heater storage tanks heated from boiler systems are installed.	**1**	0	0	☐			None
7	RF	703.5.5			**703.5.5 Solar water heater.** SRCC (Solar Rating & Certification Corporation) OG 300 rated, or equivalent, solar domestic water heating system is installed. Solar Energy Factor (SEF) as defined by SRCC is in accordance with Table 703.5.5(a) and Table 703.5.5(b).				type:			None
7	RF								SEF:			
7	RF			(a)	Storage Water Heater, Rated Storage Volume of Backup Water Heater is ≥ 0.1 Gallon and ≤ 55 Gallons, Medium Water Draw		0	0				
7	RF				SEF ≥ 1.3	**0**						
7	RF				SEF ≥ 1.51	**0**						
7	RF				SEF ≥ 1.81	**0**						
7	RF				SEF ≥ 2.31	**0**						
7	RF				SEF ≥ 3.01	**0**						
7	RF			(b)	Storage Water Heater, Rated Storage Volume of Backup Water Heater is >55 Gallons, Medium Water Draw		0	0				
7	RF				SEF ≥ 1.3	**0**						
7	RF				SEF ≥ 1.51	**0**						
7	RF				SEF ≥ 1.81	**0**						
7	RF				SEF ≥ 2.31	**0**						
7	RF				SEF ≥ 3.01	**0**						
7	F	703.6			**703.6 Lighting and appliances**							
7	F	703.6.1			**703.6.1 Hard-wired lighting.** Hard-wired lighting is in accordance with one of the following:							
7	F		(1)		A minimum percent (95%) of the total hard-wired interior luminaires or lamps qualify as ENERGY STAR, DesignLights Consortium (DLC), or applicable equivalent.	**0**	0	0	☐			None
7	F		(2)		A minimum of 80 percent of the exterior lighting wattage has a minimum efficacy of 61 lumens per watt or is solar-powered.	**1**	0	0	☐			None
7	F		(3)		In multifamily buildings, common area lighting power density (LPD) is less than 0.51 Watts per square foot.	**7**	0	0	☐			None
7	F	703.6.2			**703.6.2 Appliances.** ENERGY STAR or equivalent appliance(s) are installed:							
7	F		(1)		Refrigerator	**1**	0	0	☐			None
7	F		(2)		Dishwasher	**1**	0	0	☐			None
7	F		(3)		Washing machine	**4**	0	0	☐			None
7	F				Multifamily Building Note: Washing machines in ALL units must comply.							
7	RF	703.7			**703.7 Passive solar design**							
7	RF	703.7.1			**703.7.1 Sun-tempered design.** Building orientation, sizing of glazing, and design of overhangs are in accordance with all of the following:	**4**	0	0	☐			
7	RF		(1)		The long side (or one side if of equal length) of the building faces within 20 degrees of true south.							None
7	RF		(2)		Vertical glazing area is between 5 and 7 percent of the gross conditioned floor area on the south face [also see Section 703.7.1(8)] and glazing U-factors meet Table 703.2.5.2(a).							None
7	RF		(3)		Vertical glazing area is less than 2 percent of the gross conditioned floor area on the west face, and glazing meets Table 703.2.5.2(a).							None
7	RF		(4)		Vertical glazing area is less than 4 percent of the gross conditioned floor area on the east face, and glazing meets Table 703.2.5.2(a).							None
7	RF		(5)		Vertical glazing area is less than 8 percent of the gross conditioned floor area on the north face,							None

7	RF			and glazing meets Table 703.2.5.2(a).								
7	RF		(6)	Skylights, where installed, are in accordance with the following:								
7	RF		(a)	shades and insulated wells are used, and all glazing meets Table 703.2.5.2(a)								None
7	RF		(b)	horizontal skylights are less than 0.5 percent of finished ceiling area								None
7	RF		(c)	sloped skylights on slopes facing within 45 degrees of true south, east, or west are less than 1.5 percent of the finished ceiling area								None
7	RF		(7)	Overhangs or adjustable canopies or awnings or trellises provide shading on south-facing glass for the appropriate climate zone in accordance with Table 703.7.1(7): See Table 703.7.1(7)								None
7	RF		(8)	The south face windows have a SHGC of 0.40 or higher.								None
7	RF		(9)	Return air or transfer grilles/ducts are in accordance with Section 705.4.								None
7	RF			Multifamily Building Note: The site is designed such that at least 40 percent of the multifamily dwelling or sleeping units have one south facing wall (within 15 degrees) containing at least 50 percent of glazing for entire unit, Effective shading is required for passive solar control on all south facing glazing. The floor area of at least 15 feet from the south facing perimeter glazing is massive and exposed to capture solar heat during the day and reradiate at night.								None
7	RF	703.7.2		**703.7.2 Window shading.** Automated solar protection or dynamic glazing is installed to provide shading for windows.	1	0	0	☐				None
7	RF	703.7.3		**703.7.3 Passive cooling design.** Passive cooling design features are in accordance with three or more of the following:		0	0					
7	RF			**Points for three items:**	3							
7	RF			**Points for one additional item:**	1							
7	RF		(1)	Exterior shading is provided on east and west windows using one or a combination of the following:								
7	RF		(a)	vine-covered trellises with the vegetation separated a minimum of 1 foot (305 mm) from face of building				☐				None
7	RF		(b)	moveable awnings or louvers				☐				None
7	RF		(c)	covered porches				☐				None
7	RF		(d)	attached or detached conditioned/unconditioned enclosed space that provides full shade of east and west windows (e.g., detached garage, shed, or building)				☐				None
7	RF		(2)	Overhangs are installed to provide shading on south-facing glazing in accordance with Section 703.7.1(7). **(Points not awarded if points are taken under Section 703.7.1.)**				☐				None
7	RF		(3)	Windows and/or venting skylights are located to facilitate cross and stack effect ventilation.				☐				None
7	RF		(4)	Solar reflective roof or radiant barrier is installed in climate zones 1, 2, or 3 and roof material achieves a 3-year aged criteria of 0.50.				☐				None
7	RF		(5)	Internal exposed thermal mass is a minimum of three inches (76 mm) in thickness. Thermal mass consists of concrete, brick, and/or tile fully adhered to a masonry base or other masonry material in accordance with one or a combination of the following:								
7	RF		(a)	A minimum of 1 square foot (0.09 m^2) of exposed thermal mass of floor per 3 square feet (2.8 m^2) of gross finished floor area.				☐				None
7	RF		(b)	A minimum of 3 square feet (2.8 m^2) of exposed thermal mass in interior walls or elements per square foot (0.09 m^2) of gross finished floor area.				☐				None
7	RF		(6)	Roofing material is installed with a minimum 0.75 inch (19 mm) continuous air space offset from the roof deck from eave to ridge.				☐				None
7	RF	703.7.4		**703.7.4 Passive solar heating design**. In addition to the sun-tempered design features in Section 703.7.1, all of the following are implemented: Note: Points shall not be awarded in the Tropical Climate Zone.	4	0	0	☐				
7	RF		(1)	Additional glazing, no greater than 12 percent, is permitted on the south wall. This additional glazing is in accordance with the requirements of Section 703.7.1.								None
7	RF		(2)	Additional thermal mass for any room with south-facing glazing of more than 7 percent of the finished floor area is provided in accordance with the following:								
7	RF		(a)	Thermal mass is solid and a minimum of 3 inches (76 mm) in thickness. Where two thermal mass materials are layered together (e.g., ceramic tile on concrete base) to achieve the appropriate thickness, they are fully adhered to (touching) each other.								None
7	RF		(b)	Thermal mass directly exposed to sunlight is provided in accordance with the following minimum ratios:								None
7	RF		(i)	Above latitude 35 degrees: 5 square feet (0.465 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.								
7	RF		(ii)	Latitude 30 degrees to 35 degrees: 5.5 square feet (0.51 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.								
7	RF		(iii)	Latitude 25 degrees to 30 degrees: 6 square feet (0.557 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.								
7	RF		(c)	Thermal mass not directly exposed to sunlight is permitted to be used to achieve thermal mass requirements of Section 703.7.4 (2) based on a ratio of 40 square feet (3.72 m^2) of thermal mass for every 1 square foot (0.0929 m^2) of south-facing glazing.								None
7	RF		(3)	In addition to return air or transfer grilles/ducts required by Section 703.7.1(9), provisions for forced airflow to adjoining areas are implemented as needed.								None
7 P	RF	704 ERI TARGET PATH										
7 P	F	704.1		**704.1 ERI target compliance.** Compliance with the energy chapter shall be permitted to be based on the EPA National ERI Target Procedure for Energy Star Certified Homes. Points from Section 704 (ERI Target) shall not be combined with points from Section 702 (Performance Path) or Section 703 (Prescriptive Path). Dwelling ratings shall be submitted to a Rating Certification Body approved by the Adopting Entity for calculating points under this section.		56	0	EPA National ERI Target:				Preliminary Target & Design numbers, results from Energy Model
7 P	F	704.2		**704.2 Point calculation.** Points for Section 704 shall be computed based on Step "1" of the EPA National ERI Target Procedure. Points shall be computed individually for each building as follows: **30 + (Number of National ERI Points less than EnergyStar National ERI Target for that building) * 2.**				ERI As Designed:				
7 P	RF	705 ADDITIONAL PRACTICES										
7 P	RF	705.2		**705.2 Lighting**								
7 P	F	705.2.1		**705.2.1 Lighting controls** **(Percentages for point thresholds are based on lighting not required for means of egress or security lighting as defined by local building codes.)**								
7	F	705.2.1.1		**705.2.1.1 Interior lighting.** In dwelling units or sleeping units, permanently installed interior lighting fixtures are controlled with an occupancy sensor, or dimmer:		0	0	☐				None
7	F		(1)	50 percent to less than 75 percent of lighting fixtures.	1							
7	F		(2)	A minimum of 75 percent of lighting fixtures.	2							
7 P	F	705.2.1.2		**705.2.1.2 Exterior lighting.** Photo or motion sensors are installed on 75 percent of outdoor lighting fixtures to control lighting.	1	1	0	☐				Photo
7	F	705.2.1.3		**705.2.1.3 Multifamily common areas.**								
7	F		(1)	In a multifamily building, occupancy sensors, or dimmers are installed in common areas (except corridors and stairwells).		0	0	☐				None
7	F		(a)	50 percent to less than 75 percent of lighting fixtures.	1							
7	F		(b)	A minimum of 75 percent of lighting fixtures.	2							
7	F		(2)	In a multifamily building, occupancy controls are installed to automatically reduce light levels in interior corridors and exit stairwells when the space is unoccupied. Light levels are reduced by:		0	0	☐				None
7	F		(a)	50 percent to less than 75 percent or to local minimum requirements	2							
7	F		(b)	A minimum of 75 percent	3							
7	F	705.2.1.4		**705.2.1.4** In a multifamily building, occupancy controls are installed to automatically reduce light levels in garages and parking structures when the space is unoccupied. Light levels are reduced by:		0	0	☐				None
7	F		(1)	50 percent to less than 75 percent or to local minimum requirements	2							
7	F		(2)	A minimum of 75 percent	3							
7	RF	705.2.2		**705.2.2 TDDs and skylights.** A tubular daylighting device (TDD) or a skylight that meets the requirements of Table 703.2.5.2(a) is installed in rooms without windows. **(Points awarded per building.)**	2	0	0	☐				None
7	F	705.2.3		**705.2.3 Lighting outlets.** Occupancy sensors are installed for a minimum of 80 percent of hard-wired lighting outlets in the interior living space.	1	0	0	☐				None
7 P	F	705.2.4		**705.2.4 Recessed luminaires.** The number of recessed luminaires that penetrates the thermal envelope is less than 1 per 400 square feet (37.16 m^2) of total conditioned floor area and they are in accordance with Section **701.4.3.5**.	1	1	0	# of luminaires: per 0 square feet				None
7	F	705.3		**705.3 Induction cooktop.** Induction cooktop is installed.	1	0	0	☐				None

7 P RF	705.4		**705.4 Return ducts and transfer grilles.** Return ducts or transfer grilles are installed in every room with a door. Return ducts or transfer grilles are not required for bathrooms, kitchens, closets, pantries, and laundry rooms.	2	2	0	☐		None
7 P RF	705.5		**705.5 HVAC design and installation**						
7 RF	705.5.1		**705.5.1** Meet one or both of the following:						
7 RF		(1)	HVAC contractor is certified by the Air Conditioning Contractors of Americas Quality Assured Program (ACCA/QA) or by an EPA-recognized HVAC Quality Installation Training Oversight Organization (H-QUITO) or equivalent.	1	0	0	☐		need to check on this
7 RF		(2)	HVAC installation technician(s) is certified by North American Technician Excellence, Inc. (NATE) or equivalent.	1	0	0	☐		None
7 F	705.5.2		**705.5.2** Performance of the heating and/or cooling system is verified by the HVAC contractor in accordance with all of the following:	3	0	0	☐		None
7 F		(1)	Start-up procedure is performed in accordance with the manufacturer's instructions.						None
7 F		(2)	Refrigerant charge is verified by super-heat and/or sub-cooling method.						None
7 F		(3)	Burner is set to fire at input level listed on nameplate.						None
7 F		(4)	Air handler setting/fan speed is set in accordance with manufacturer's instructions.						None
7 F		(5)	Total airflow is within 10 percent of design flow.						None
7 F		(6)	Total external system static does not exceed equipment capability at rated airflow.						None
7 P RF	705.5.3		**705.5.3** HVAC Design is verified by 3rd party as follows:						
7 F		(1)	The ENERGY STAR HVAC Design and Rater Design Review Checklists are completed and correct.	3	0	0	☐		None
7 P F		(2)	HVAC Installation is inspected and conforms to HVAC design documents and plans.	3	3	0	☐		None
7 P RF	705.6		**705.6 Installation and performance verification.**						
7 P RF	705.6.1		**705.6.1** Third-party on-site inspection is conducted to verify compliance with all of the following, as applicable. Minimum of two inspections are performed: one inspection after insulation is installed and prior to covering, and another inspection upon completion of the building. Where multiple buildings or dwelling units of the same model or sleeping units of the same model are built by the same builder, a representative sample inspection of a minimum of 15 percent of the buildings or dwelling units or sleeping units is permitted.	3	3	0	By using this tool, this project automatically qualifies for this practice.		None
7 F	705.6.2		**705.6.2 Testing.** Testing is conducted to verify performance:						
7 F	705.6.2.1		**705.6.2.1 Air leakage validation of building or dwelling units or sleeping units.** A visual inspection is performed as described in 701.4.3.2(2) and air leakage testing is performed in accordance with ASTM E779 or ASTM E1827. **(Points awarded only for buildings where building envelope leakage testing is not required by ICC IECC.)** **(Points not awarded if points are taken under Section 703.2.4)**				ACH50:		
7 F		(1)	A blower door test.	3	0	0	ELR:		None
7 F		(2)	Third-party verification is completed. NOTE: Specify name of person or company conducting blower door test in the assigned Notes area.	5	0	0	☐		None
7 F	705.6.2.2		**705.6.2.2 HVAC airflow testing.** Balanced HVAC airflows are demonstrated by flow hood or other acceptable flow measurement tool by a third party. Test results are in accordance with the following:						
7 F		(1)	Measured flow at each supply and return register meets or exceeds the requirements in ACCA 5 QI-2010, Section 5.2.	5	0	0	☐		None
7 F		(2)	Total airflow meets or exceeds the requirements in ACCA 5 QI-2010, Section 5.2. NOTE: Specify name of person or company conducting HVAC airflow test in the assigned Notes area.	3	0	0	☐		None
7 F	705.6.2.3		**705.6.2.3 HVAC duct leakage testing.** One of the following is achieved: **(Points awarded only where these practices are not required by IECC.)** **(Points not awarded if points are taken under Section 703.4.4)**		0	0			None
7 F		(1)	Duct leakage is in accordance with IECC R403.3.3 and R403.3.4.	3					
7 F		(2)	Duct leakage is in accordance with IECC R403.3.3 and R403.3.4, and testing is conducted by an independent third party.	5					
7 R	705.6.3		**705.6.3 Insulating hot water pipes.** Insulation with a minimum thermal resistance (R-value) of at least R-3 is applied to the following, as applicable: **(Points awarded only where these practices are not required by IECC.)**	1	0	0	☐ required by IECC: ☐		
7 R		(a)	piping 3/4-inch and larger in outside diameter						None
7 R		(b)	piping serving more than one dwelling unit or sleeping unit						None
7 R		(c)	piping located outside the conditioned space						None
7 R		(d)	piping from the water heater to a distribution manifold						None
7 R		(e)	piping located under a floor slab						None
7 R		(f)	buried piping						None
7 R		(g)	supply and return piping in recirculation systems other than demand recirculation systems						None
7 RF	705.6.4		**705.6.4 Potable hot water demand re-circulation system.**						
7 RF	705.6.4.1		**705.6.4.1** Potable hot water demand re-circulation system is installed in a single-family unit.	1	0	0	☐		None
7 RF	705.6.4.2		**705.6.4.2** Potable hot water demand re-circulation system(s) that serves every unit in a multifamily building is installed in place of a standard circulation pump and control.	2	0	0	☐		None
7 P F	705.7		**705.7** In multi-unit buildings, an advanced electric and fossil fuel submetering system is installed to monitor electricity and fossil fuel consumption for each unit. The device provides consumption information on a monthly or near real-time basis. The information is available to the occupants at a minimum on a monthly basis.	1	1	0	☐		None
7 P RF	706 INNOVATIVE PRACTICES								
7 F	706.1		**706.1 Energy consumption control.** A whole-building or whole-dwelling unit or whole-sleeping unit device or system is installed that controls or monitors energy consumption.	3 Max	0	0			
7 F		(1)	programmable communicating thermostat with the capability to be controlled remotely	1			☐		None
7 F		(2)	energy-monitoring device or system	1			☐		None
7 F		(3)	energy management control system	3			☐		None
7 F		(4)	programmable thermostat with control capability based on occupant presence or usage pattern	1			☐		None
7 F		(5)	lighting control system	1			☐		None
7 F	706.2		**706.2 Renewable energy service plan.** Renewable energy service plan is provided as follows:						
7 F		(1)	Builder selects a renewable energy service plan provided by the local electrical utility for interim (temporary) electric service, or purchases renewable energy certificates (RECs) to cover electricity used. The builder's local administrative office has renewable energy service or has otherwise been paired with RECs. Green-ecertified (or equivalent) is required for renewable electricity purchases.	1	0	0	☐		None
7 F		(2)	The buyer of the building selects one of the following renewable energy service plans provided by the utility prior to occupancy of the building with a minimum two-year commitment.		0	0			None
7 F		(a)	less than half of the dwelling's projected electricity and gas use is provided by renewable energy	1					
7 F		(b)	half or more of the of the dwelling's projected electricity and gas use is provided by renewable energy	2					
7 F	706.3		**706.3 Smart Appliances and Systems.** Smart appliances and systems are installed as follows:		0	0			None
7 F			Three to five smart appliances installed	1					
7 F			Six or more smart appliances installed	2					
7 F			**(Items (7) and (8) are permitted to count as two appliances each for the purpose of awarding points.)**						
7 F			**(where points awarded in Section 706.3, points shall not be awarded in Section 706.7 and 706.9)**						
7 F		(1)	Refrigerator				☐		None
7 F		(2)	Freezer				☐		None
7 F		(3)	Dishwasher				☐		None
7 F		(4)	Clothes Dryer				☐		None
7 F		(5)	Clothes Washer				☐		None
7 F		(6)	Room Air Conditioner				☐		None
7 F		(7)	HVAC Systems				☐		None
7 F		(8)	Service Hot Water Heating Systems				☐		None

7	F	**706.4**		**706.4 Pumps.**							
7	F	**706.4.1**		**706.4.1** Pool, spa, and water features equipped with filtration pumps as follows:							
7	F		**(1)**	Electronically controlled variable-speed pump(s) is installed (full load efficiency of 90 percent or greater).	**1**	0	0	☐			None
7	F		**(2)**	Electronically controlled variable-speed pump(s) is installed (full load efficiency of 90 percent or greater) in a pool	**3**	0	0	☐			will this be added?
7	F	**706.4.2**		**706.4.2** Sump pump(s) with electrically commutated motors (ECMs) or permanent split capacitor (PSC) motors is installed (full load efficiency of 90 percent or greater).	**1**	0	0	☐			None
7	F	**706.5**		**706.5 On-site renewable energy system.** One of the following options is implemented							None
7	F		**(1)**	Building is Solar-Ready in compliance with IECC Appendix A Solar Ready Provisions.	**1**	0	0	☐	kW per 0 units:		
7	F		**(2)**	An on-site renewable energy system(s) is installed on the property.	**2 per kW**	0	0		kWh of strg. per 0 units:		
7	F		**(3)**	An on-site renewable energy system(s) and a battery energy storage system are installed on the property.	**2 per kW, 1 per 2 kWh**	0	0				
7	F			**Points awarded shall not be combined with points for renewable energy in another section of this chapter. Points shall not be awarded for solar thermal or geothermal systems that provide space heating, space cooling, or water heating, points for these systems are awarded in § 703. Where onsite renewable energy is included in § 702 Performance Path or 704 ERI Target Path, § 706.5 shall not be awarded. The solar-ready zone roof area in #1 is area per dwelling unit. Points in item #2 and #3 shall be divided by the number of dwelling units.**							
7	F			***Multifamily Building Note:*** *Conditioned common area and non-residential space is excluded for the purpose of calculating number of units.*							
7	RF	**706.6**		**706.6 Parking garage efficiency.** Structured parking garages are designed to require no mechanical ventilation for fresh air requirements.	**2**	0	0	☐			None
7	F	**706.7**		**706.7 Grid-interactive electric thermal storage system.** A grid-interactive electric thermal storage system is installed.							
7	F		**(1)**	Grid-Interactive Water Heating System	**1**	0	0	☐			None
7	F		**(2)**	Grid-Interactive Space Heating and cooling System **(where points awarded in Section 706.7, points shall not be awarded in Section 706.3 and 706.9)**	**1**	0	0	☐			None
7	RF	**706.8**		**706.8 Electrical vehicle charging station.** A Level 2 (208/240V 40-80 amp) or Level 3 electric vehicle charging station is installed on the building site. (Note: Charging station shall not be included in the building energy consumption.)	**2**	0	0	☐			Will level 2 EV charger be installed
7	RF	**706.9**		**706.9 CNG vehicle fueling station.** A CNG vehicle residential fueling appliance is installed on the building site. The CNG fueling appliances shall be listed in accordance with ANSI/CSA NGV 5.1 and installed in accordance to the appliance manufacturer's installation instructions. (Note: The fueling appliance shall not be included in the building energy consumption.)	**1**	0	0	☐			None
7	F	**706.10**		**706.10 Automatic demand response.** Automatic demand response system is installed that curtails energy usage upon a signal from the utility or an energy service provider is installed. **(where points awarded in Section 706.10, points shall not be awarded in Section 706.3 and 706.7)**	**1**	0	0	☐			None
7	RF	**706.11**		**706.11 Grid-interactive battery storage system.** A grid-interactive battery storage system of not less than 6 kWh of available capacity is installed.	**2**	0	0	☐			None
7	RF	**706.12**		**706.12 Smart ventilation.** A whole-building ventilation systems is installed with automatic ventilation controls to limit ventilation during periods of extreme temperature, extreme humidity, and/or during times of peak utility loads and is in accordance with the specifications of ASHRAE Standard 62.2-2010 Section 4.	**1**	0	0	☐			None
7	F	**706.13**		**706.13 Alternative refrigerant.** Use of the following in mechanical space cooling systems for dwellings.		0	0				None
7	F		**(1)**	Use alternative refrigerant with a GWP < 1000	**1**						
7	F		**(2)**	Do not use refrigerants	**2**						
7	RF	**706.14**		**706.14 Third-party utility benchmarking service.**							
7	RF		**(1)**	For a multifamily building, the owner has contracted with a third-party utility benchmarking service with at least five (5) years of experience in utility data management and analysis to perform a monthly analysis of whole-building energy and water consumption for a minimum of 1 year.	**3**	0	0	☐			None
7	F		**(2)**	The building owner commits to reporting energy data using U.S. Environmental Protection Agency's ENERGY STAR Portfolio Manager for a minimum of three years.	**1**	0	0	☐			None
7	RF	**706.15**		**706.15 Entryway air seal.** For multifamily buildings, where not required by the building or energy code, to slow the movement of unconditioned air from outdoors to indoors at the main building entrance, the following is installed:							
7	RF		**(1)**	Building entry vestibule.	**2**	0	0	☐			None
7	RF		**(2)**	Revolving entrance doors.	**2**	0	0	☐			None

801 INDOOR AND OUTDOOR WATER USE

801.0 **801.0 Intent.** Implement measures that reduce indoor and outdoor water usage. Implement measures that include collection and use of alternative sources of water. Implement measures that treat water on site.

801.1 **801.1 Mandatory requirements.** The building shall comply with Section 802 (Prescriptive Path) and 803 (Innovative Practices) or Section 804 (Performance Path). Points from Section 804 (Performance Path) shall not be combined with points from Section 802 (Prescriptive Path) or Section 803 (Innovative Practices). The mandatory provisions of Section 802 (Prescriptive Path) are required when using the Water Rating Index of Section 804 (Performance Path) for Chapter 8 Water Efficiency compliance.

None

802 PRESCRIPTIVE PATH

802.1 **802.1 Indoor hot water usage.** Indoor hot water supply system is in accordance with one of the practices listed in items (1) through (5). The maximum water volume from the source of hot water to the termination of the fixture supply is determined in accordance with Tables 802.1(1) or 802.1(2). The maximum pipe length from the source of hot water to the termination of the fixture supply is 50 feet.

(Where more than one water heater is used or where more than one type of hot water supply system, including multiple circulation loops, is used, points are awarded only for the system that qualifies for the minimum number of points.)

(Systems with circulation loops are eligible for points only if pumps are demand controlled. Circulation systems with timers or aquastats and constant-on circulation systems are not eligible to receive points.)

(Points awarded only if the pipes are insulated in accordance with Section 705.6.3.)

See Table 802.1(1)

See Table 802.1(2)

(1)	The maximum volume from the water heater to the termination of the fixture supply at furthest fixture is 128 ounces (1 gallon or 3.78 liters).	**8**			None
(2)	The maximum volume from the water heater to the termination of the fixture supply at furthest fixture is 64 ounces (0.5 gallon or 1.89 liters).	**12**			
(3)	The maximum volume from the water heater to the termination of the fixture supply at furthest fixture is 32 ounces (0.25 gallon or 0.945 liters).	**20**			
(4)	A demand controlled hot water priming pump is installed on the main supply pipe of the circulation loop and the maximum volume from this supply pipe to the furthest fixture is 24 ounces (0.19 gallons or 0.71 liters).	**24**			
(a)	The volume in the circulation loop (supply) from the water heater or boiler to the branch for the furthest fixture is no more than 128 ounces (1 gallon or 3.78 liters).	**4 Additional**			
(5)	A central hot water recirculation system is implemented in multifamily buildings in which the hot water line distance from the recirculating loop to the engineered parallel piping system (i.e., manifold system) is less than 30 feet (9,144 mm) and the parallel piping to the fixture fittings contains a maximum of 64 ounces (1.89 liters) (115.50 cubic inches) (0.50 gallons).	**9**			None
(6)	Tankless water heater(s) with at least 0.5 gallon (1.89 liters) of storage are installed, or a tankless water heater that ramps up to at least 110F within 5 seconds is installed. The storage may be internal or external to the tankless water heater.	**1 Additional**	0	0	None

802.2 **802.2 Water-conserving appliances.** Energy Star or equivalent water-conserving appliances are installed.

(1)	dishwasher	**2**	2	0	None
(2)	clothes washer, or	**13**	13	0	dishwasher will need to be ENERGY STAR for HUD-MIP requirements
(3)	clothes washer with an Integrated Water Factor of 3.8 or less	**18**			

NOTE: If multiple dishwashers and washing machines are installed, ALL instances must meet the above conditions to be awarded points.

Multifamily Building Note: Washing machines are installed in individual units or provided in common areas of multifamily buildings.

802.3 **802.3 Water usage metering.** Water meters are installed meeting the following:

(1)	Single-Family Buildings: Water Usage Metering:				
(a)	Where not otherwise required by the local AHJ, installation of a meter for water consumed from any source associated with the building or building site.	**2 per unique meter**	0	0	None
(b)	Each water meter shall be capable of communicating water consumption data remotely for the dwelling unit occupant and be capable of providing daily data with electronic data storage and reporting capability that can produce reports for daily, monthly, and yearly water consumption. (Fire sprinkler systems are not required to be metered).	**2 per sensor package**	0	0	None
(2)	Multi-Family Buildings: Water Usage Metering: **(Points earned in Section 802.3(2) shall not exceed 50% of the total points earned for Chapter 8)**				
(a)	Where not otherwise required by the local AHJ, installation of a meter for water consumed from any source associated with the building or building site.	**2 per unique use meter**	0	0	Will units be submetered?
(b)	Each water meter shall be capable of communicating water consumption data remotely for the dwelling unit occupant and be capable of providing daily data with electronic data storage and reporting capability that can produce reports for daily, monthly, and yearly water consumption. (Fire sprinkler systems are not required to be metered).	**2 per sensor package**	0	0	None

802.4 **802.4 Showerheads.** Showerheads are in accordance with the following: # of compartments:

(1)	The total maximum combined flow rate of all showerheads in a shower compartment with floor area of 2600 square inches or less is equal or less than 2.0 gpm. For each additional 1300 square inches or any portion thereof of shower compartment floor area, an additional 2.0 gpm combined showerhead flow rate is allowed. Showerheads shall comply with ASME A112.18.1/CSA B125.1 and shall meet the performance criteria of the U.S. EPA WaterSense Specification for showerheads. Showerheads shall be served by an automatic compensating valve that complies with ASSE 1016/ASME A112.1016/CSA B125.16 or ASME A112.18.1/CSA B125.1 and specifically designed to provide thermal shock and scald protection at the flow rate of the showerhead.	**4 for first compartment** **1 for each additional compartment in dwelling**	4	0	Needs to be a WaterSense Certified fixture
	(Points awarded per shower compartment. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)	**7 Max**			
(2)	All shower compartments in the dwelling unit(s) or sleeping unit(s) and common areas meet the requirements of 802.4(1) and all showerheads are in accordance with one of the following:		6	0	1.8 GPM or less fixture
(a)	maximum of 1.8 gpm	**6 Additional**			
(b)	maximum of 1.5 gpm	**10 Additional**			
(3)	Any shower control that can shut off water flow without affecting temperature is installed. **(Points awarded per shower control.)**	**1** **3 Max**	0	0	None

802.5 **802.5 Faucets**

802.5.1 **802.5.1** Install water-efficient lavatory faucets with flow rates not more than 1.5 gpm (5.68 L/m), tested in compliance with ASME A112.18.1/CSA B125.1 and meeting the performance criteria of the EPA WaterSense High-Efficiency Lavatory Faucet Specification: 7 0 Current using 1.5 gpm for lavs will this be 1.2 gpm?

(1)	Flow rate ≤ 1.5 gpm (*all faucets in a bathroom are in compliance) **(Points awarded for each bathroom. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)**	**1** **3 Max**	
(2)	Flow rate ≤ 1.2 gpm (*all faucets in a bathroom are in compliance)	**2 (6 Max)**	
(3)	Flow rate ≤ 1.5 gpm for all lavatory faucets in the dwelling unit(s) or sleeping unit(s)	**6 Additional**	
(4)	Flow rate ≤ 1.5 gpm for all lavatory faucets in the dwelling unit(s), and at least one bathroom has faucets with flow rates ≤ 1.2 gpm	**8 Additional**	
(5)	Flow rate ≤ 1.2 gpm for all lavatory faucets in the dwelling unit(s)	**12 Additional**	

802.5.2 **802.5.2** Water-efficient residential kitchen faucets are installed in accordance with ASME A112.18.1/CSA B125.1. Residential kitchen faucets may temporarily increase the flow above the maximum rate but not to exceed 2.2 gpm. 0 0 None

(1)	All residential kitchen faucets have a maximum flow rate of 1.8 gpm.	**3**
(2)	All residential kitchen faucets have a maximum flow rate of 1.5 gpm.	**1 Additional**

802.5.3 **802.5.3** Self-closing valve, motion sensor, metering, or pedal-activated faucet is installed to enable intermittent on/off operation. **(Points awarded per fixture.)** **1** **3 Max** 0 0 None

802.5.4 **802.5.4 Water closets and urinals.** Water closets and urinals are in accordance with the following:

(1)	Gold and emerald levels: All water closets and urinals are in accordance with Section 802.5.4.	**Gold/Emerald not available**			None

8 P	F		(2)	A water closet is installed with an effective flush volume of 1.28 gallons (4.85 L) or less in accordance with ASME A112.19.2/CSA B45.1 or ASME A112.19.14 as applicable. Tank-type water closets shall be in accordance with the performance criteria of the U.S. EPA WaterSense Specification for Tank-Type Toilets. **(Points awarded per fixture. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)**	**4 12 Max**	4	0			CST744EN model number for the commode spe'd as 1.28 gpf
8 P	F		(3)	All water closets are in accordance with Section 802.5.4(2).	**17 Additional**	13	0	☐		None
8	F		(4)	All water closets are in accordance with Section 802.5.4(2) and one or more of the following are installed:						
8	F		(a)	Water closets that have an effective flush volume of 1.2 gallons or less. **(Points awarded per toilet. In multifamily buildings, the average of the points assigned to individual dwelling units or sleeping units may be used as the number of points awarded for this practice, rounded to the nearest whole number.)**	**2 Additional 6 Max**	0	0			None
8	F		(b)	One or more urinals with a flush volume of 0.5 gallons (1.9L) or less when tested in accordance with ASME A112.19.2/CSA B45.1.	**2 Additional**	0	0	☐		None
8	F		(c)	One or more composting or waterless toilets and/or nonwater urinals. Nonwater urinals shall be tested in accordance with ASME A112.19.2/CSA B45.1.	**12 Additional**	0	0	☐		None
8 P	F	**802.6**		**802.6 Irrigation systems**						
8 P	F	**802.6.1**		**802.6.1** Where an irrigation system is installed, an irrigation plan and implementation are executed by a qualified professional or equivalent.	**Mandatory**					None
8 P	F									
8	F	**802.6.2**		**802.6.2** Irrigation sprinkler nozzles shall be tested according to ANSI standard ASABE/ICC 802-2014 Landscape Irrigation Sprinkler and Emitter Standard by an accredited third party laboratory.	**6**	0	0	☐		None
8	F									
8	F	**802.6.3**		**802.6.3** Drip irrigation is installed.						
8	F		(1)	Drip irrigation is installed for all landscape beds.	**4**	0	0	☐		will this be done
8	F		(2)	Subsurface drip is installed for all turf grass areas.	**4**	0	0	☐		None
8	F		(3)	Drip irrigation zones specifications show plant type by name and water use/need for each emitter (Points awarded only if specifications are implemented.)	**5**	0	0	☐		None
8	F	**802.6.4**		**802.6.4** The irrigation system(s) is controlled by a smart controller or no irrigation is installed. **(Points are not additive.)**						
8	F		(1)	Irrigation controllers shall be in accordance with the performance criteria of the EPA WaterSense program	**10**	0	0	☐		None
8	F		(2)	No irrigation is installed and a landscape plan is developed in accordance with Section 503.5, as applicable. NOTE: 5 Points must be taken in 503.5(1)-(7) for a Full Landscape Plan in order to receive points for 802.6.4(2).	**15**	0	0	☐		None
8	F	**802.6.5**		**802.6.5 Commissioning and water use reduction for irrigation systems.** *[Points are not additive per each section.]*						
8	F		(1)	All irrigation zones utilize pressure regulation so emission devices (sprinklers and drip emitters) operate at manufacturer's recommended operating pressure.	**3**	0	0	☐		None
8	F		(2)	Where dripline tubing is installed, a filter with mesh size in accordance with the manufacturer's recommendation is installed on all drip zones.	**3**	0	0	☐		None
8	F		(3)	Utilize spray bodies that incorporate an in-stem or external flow shut-off device.	**3**	0	0	☐		None
8	F		(4)	For irrigation systems installed on sloped sites, either an in-stem or external check valve is utilized for each spray body.	**3**	0	0	☐		None
8	F		(5)	Where an irrigation system is installed, a flow sensing device is installed to monitor and alert the controller when flows are outside design range.	**3**	0	0	☐		None
8	F	**802.7**		**802.7 Rainwater collection and distribution.** Rainwater collection and distribution is provided.						
8	F	**802.7.1**		**802.7.1** Rainwater is used for irrigation in accordance with one of the following:		0	0			None
8	F		(1)	Rainwater is diverted for landscape irrigation without impermeable water storage	**5**					
8	F		(2)	Rainwater is diverted for landscape irrigation with impermeable water storage in accordance with one of the following:						
8	F		(a)	50 – 499 gallon storage capacity	**5**					
8	F		(b)	500 – 2499 gallon storage capacity	**10**					
8	F		(c)	2500 gallon or larger storage capacity (system is designed by a professional certified by The American Rainwater Catchment Systems Association or equivalent)	**15**					
8	F		(d)	All irrigation demands are met by rainwater capture (documentation demonstrating the water needs of the landscape is provided and the system is designed by a professional certified by The American Rainwater Catchment Systems Association or equivalent).	**25**					
8	F	**802.7.2**		**802.7.2** Rainwater is used for indoor domestic demand as follows. The system is designed by a professional certified by The American Rainwater Catchment Systems Association or equivalent.		0	0			
8	F		(1)	Rainwater is used to supply an indoor appliance or fixture for any locally approved use. **(Points awarded per appliance or fixture.)**	**5 15 Max**					None
8	F		(2)	Rainwater provides for total domestic demand.	**25**			☐		None
8	F	**802.8**		**802.8 Sediment filters.** Water filter is installed to reduce sediment and protect plumbing fixtures for the whole building or the entire dwelling unit.	**1**	0	0	☐		None
8 P	F	**802.9**		**802.9 Water treatment devices.**						
8	F	**802.9.1**		**802.9.1** Water Softeners shall not be installed where the supplied water hardness is less than 8.0 grains per gallon measured as total calcium carbonate equivalents. Water softeners shall be listed to NSF 44 and a rated salt efficiency of 3400 grains of total hardness per 1.0 pound of salt based on sodium chloride equivalency. Devices shall not discharge more than 4.0 gallons of water per 1000 grains of hardness removed during the service or recharge cycle.		0	0			None
8	F		(1)	No water softener.	**5**					
8	F		(2)	Water softener installed to supply softened water only to domestic water heater.	**2**					
8	F	**802.9.2**		**802.9.2** Reverse Osmosis (R/O) water treatment systems shall be listed to NSF 58 and shall include automatic shut-off valve to prevent water discharge when storage tank is full.		0	0			None
8	F		(1)	No R/O system.	**3**					
8	F		(2)	Combined capacity of all R/O systems does not exceed 0.75 gallons.	**1**					
8 P	F	**802.10**		**802.10 Pools and spas.**						
8 P	F	**802.10.1**		**802.10.1** Pools and Spas with water surface area greater than 36 square feet and connected to a water supply shall have a dedicated meter to measure the amount of water supplied to the pool or spa.	**Mandatory**					Pool needs to be submetered
8	F		(1)	Automated motorized non-permeable pool cover that covers the entire pool surface.	**10**	0	0	☐		None
8 P	RF	**803 INNOVATIVE PRACTICES**								
8	RF	**803.1**		**803.1 Reclaimed, gray, or recycled water**. Reclaimed, gray, or recycled water is used as permitted by applicable code. **(Points awarded for either Section 803.1(1) or 803.1(2), not both.)** **(Points awarded for either Section 803.6 or 803.1, not both.)**		0	0			
8	RF		(1)	each water closet flushed by reclaimed, gray, or recycled water **(Points awarded per fixture or appliance.)**	**5 20 Max**					None
8	RF		(2)	irrigation from reclaimed, gray, or recycled water on-site	**10**			☐		None
8	RF	**803.2**		**803.2 Reclaimed water, graywater, or rainwater pre-piping.** Reclaimed, graywater, or rainwater systems are rough plumbed (and permanently marked, tagged or labeled) into buildings for future use.	**3 per roughed in system**	0	0	# of systems:		None
8	F	**803.3**		**803.3 Automatic leak detection and control devices.** One of the following devices is installed. Where a fire sprinkler system is present, ensure the device will be installed to not interfere with the operation of the fire sprinkler system.	**2**	0	0			None
8	F		(1)	automatic water leak detection and control devices						
8	F		(2)	automatic water leak detection and shutoff devices						
8	F	**803.4**		**803.4 Engineered biological system or intensive bioremediation system.** An engineered biological system or intensive bioremediation system is installed and the treated water is used on site. Design and implementation are approved by appropriate regional authority.	**20**	0	0	☐		None
8	F	**803.5**		**803.5 Recirculating humidifier.** Where a humidifier is required, a recirculating humidifier is used in lieu of a traditional "flow through" type.	**1**	0	0	☐		None
8	F	**803.6**		**803.6 Advanced wastewater treatment system.** Advanced wastewater (aerobic) treatment system is installed and treated water is used on site. **(Points awarded for either Section 803.6 or 803.1, not both.)**	**20**	0	0	☐		None
8 P	RF	**804 PERFORMANCE PATH**								
8 P	RF	**804.1**		**804.1 Performance Path.** The index score for the Performance Path shall be calculated in accordance with Appendix D Water Rating Index (WRI) or equivalent methodology.	**None**			WRI		

8	P	RF	804.2	**804.2 Water efficiency rating levels.** In lieu of threshold levels for Chapter 8 in Table 303, rating levels for Section 804.1 are in accordance with Table 804.2.	None		None
8	P	RF	804.3	**804.3 Water efficiency NGBS points equivalency.** The additional points for use with Table 303 from the Chapter 8 Water Efficiency Category are determined in accordance with equation 804.3.	0	0	
8	P	RF		**Equation 804.3**			
8	P	RF		**NGBS = WRI x (-2.29) + 181.7**			

9 P RF	**901 POLLUTANT SORCE CONTROL**													
9		**901.0**			**901.0 Intent.** Pollutant sources are controlled.									
9 P RF		**901.1**			**901.1 Space and water heating options**									
9 RF		**901.1.1**			**901.1.1** Natural draft furnaces, boilers, or water heaters are not located in conditioned spaces, including conditioned crawlspaces, unless located in a mechanical room that has an outdoor air source and is sealed and insulated to separate it from the conditioned space(s).	**5**	0	0	☐		None
9 RF					**(Points are awarded only for buildings that use natural draft combustion space or water heating equipment.)**						
9 R		**901.1.2**			**901.1.2** Air handling equipment or return ducts are not located in the garage, unless placed in isolated, air-sealed mechanical rooms with an outside air source.	**5**	0	0	☐		None
9 R					Not available if there is no attached garage						
9 RF		**901.1.3**			**901.1.3** The following combustion space heating or water heating equipment is installed within conditioned space:						
9 RF			**(1)**		all furnaces or all boilers		0	0			None
9 RF				**(a)**	power vent furnace(s) or boiler(s)	**3**					
9 RF				**(b)**	direct vent furnace(s) or boiler(s)	**5**					
9 RF			**(2)**		all water heaters		0	0			None
9 RF				**(a)**	power vent water heater(s)	**3**					
9 RF				**(b)**	direct vent water heater(s)	**5**					
9 P R		**901.1.4**			**901.1.4** Gas-fired fireplaces and direct heating equipment is listed and is installed in accordance with the NFPA 54, ICC IFGC, or the applicable local gas appliance installation code. Gas-fired fireplaces within dwelling units or sleeping units and direct heating equipment are vented to the outdoors. Alcohol burning devices and kerosene heaters are vented to the outdoors.	**Mandatory**					None
9 RF		**901.1.5**			**901.1.5** Natural gas and propane fireplaces are direct vented, have permanently fixed glass fronts or gasketed doors, and comply with CSA Z21.88/CSA 2.33 or CSA Z21.50b/CSA 2.22b.	**7**	0	0	☐		None
9 P RF		**901.1.6**			**901.1.6** The following electric equipment is installed:		5	0			None
9 P RF			**(1)**		heat pump air handler in unconditioned space	**2**					
9 P RF			**(2)**		heat pump air handler in conditioned space	**5**					
9 P RF		**901.2**			**901.2 Solid fuel-burning appliances**						
9 P RF		**901.2.1**			**901.2.1** Solid fuel-burning fireplaces, inserts, stoves and heaters are code compliant and are in accordance with the following requirements:						
9 P RF			**(1)**		Site-built masonry wood-burning fireplaces use outside combustion air and include a means of sealing the flue and the combustion air outlets to minimize interior air (heat) loss when not in operation.	**Mandatory** **4**	0	0			None
9 P RF			**(2)**		Factory-built, wood-burning fireplaces are in accordance with the certification requirements of UL 127 and are an EPA Phase 2 Emission Level Qualified Model.	**Mandatory** **6**	0	0			None
9 P RF			**(3)**		Wood stove and fireplace inserts, as defined in UL 1482 Section 3.8, are in accordance with the certification requirements of UL 1482 and are in accordance with the emission requirements of the EPA Certification and the State of Washington WAC 173-433-100(3).	**Mandatory** **6**	0	0			None
9 P RF			**(4)**		Pellet (biomass) stoves and furnaces are in accordance with ASTM E1509 or are EPA certified.	**Mandatory** **6**	0	0			None
9 P RF			**(5)**		Masonry heaters are in accordance with the definitions in ASTM E1602 and ICC IBC Section 2112.1.	**Mandatory** **6**	0	0			None
9 P RF		**901.2.2**			**901.2.2** Fireplaces, woodstoves, pellet stoves, or masonry heaters are not installed.	**6**	6	0	☐		None
9 P RF		**901.3**			**901.3 Garages.** Garages are in accordance with the following:						
9 P RF			**(1)**		Attached garage						
9 P F				**(a)**	Doors installed in the common wall between the attached garage and conditioned space are tightly sealed and gasketed.	**Mandatory** **2**	0	0			None
9 P R				**(b)**	A continuous air barrier is provided separating the garage space from the conditioned living spaces.	**Mandatory** **2**	0	0			None
9 F				**(c)**	For one- and two-family dwelling units, a 100 cfm (47 L/s) or greater ducted or 70 cfm (33 L/s) cfm or greater unducted wall exhaust fan is installed and vented to the outdoors and is designed and installed for continuous operation or has controls (e.g., motion detectors, pressure switches) that activate operation for a minimum of 1 hour when either human passage door or roll-up automatic doors are operated. For ducted exhaust fans, the fan airflow rating and duct sizing are in accordance with ASHRAE Standard 62.2-2007 Section 7.3.	**8**	0	0	☐		None
9 P RF			**(2)**		A carport is installed, the garage is detached from the building, or no garage is installed.	**10**	10	0	☐		None
9 P RF		**901.4**			**901.4** Wood materials. A minimum of 85 percent of material within a product group (i.e., wood structural panels, countertops, composite trim/doors, custom woodwork, and/or component closet shelving) is manufactured in accordance with the following:	**10 Max**	0	0			
9 P R			**(1)**		Structural plywood used for floor, wall, and/or roof sheathing is compliant with DOC PS 1 and/or DOC PS 2. OSB used for floor, wall, and/or roof sheathing is compliant with DOC PS 2. The panels are made with moisture-resistant adhesives. The trademark indicates these adhesives as follows: Exposure 1 or Exterior for plywood, and Exposure 1 for OSB.	**Mandatory**					None
9 P R					NOTE: If "N/A" is selected, please explain in the Notes area.						
9 RF					Countertops						None
9 RF					Composite trim/doors						
9 RF					Custom woodwork						
9 RF					Component closet shelving						
9 RF			**(2)**		Particleboard and MDF (medium density fiberboard) is manufactured and labeled in accordance with CPA A208.1 and CPA A208.2, respectively.	**2**					
9 RF			**(3)**		Hardwood plywood in accordance with HPVA HP-1.	**2**					
9 RF			**(4)**		Particleboard, MDF, or hardwood plywood is in accordance with CPA 4.	**3**					
9 RF			**(5)**		Composite wood or agrifiber panel products contain no added urea-formaldehyde or are in accordance with the CARB *Composite Wood Air Toxic Contaminant Measure Standard* .	**4**					
9 RF			**(6)**		Non-emitting products.	**4**					
9 F		**901.5**			**901.5 Cabinets.** A minimum of 85 percent of installed cabinets are in accordance with one or both of the following:						
9 F					**(Where both of the following practices are used, only 3 points are awarded.)**						
9 F			**(1)**		All parts of the cabinet are made of solid wood or non-formaldehyde emitting materials such as metal or glass.	**5**	0	0	☐		None
9 F			**(2)**		The composite wood used in wood cabinets is in accordance with CARB *Composite Wood Air Toxic Contaminant Measure Standard* or equivalent as certified by a third-party program such as, but not limited to, those in Appendix B.	**3**	0	0	☐		None
9 P F		**901.6**			**901.6 Carpets.** Wall-to-wall carpeting is not installed adjacent to water closets and bathing fixtures.	**Mandatory**			☐		None
9 F		**901.7**			**901.7 Floor materials.** The following types of finished flooring materials are used. The materials have emission levels in accordance with CDPH/EHLB Standard Method v1.1. Product is tested by a laboratory with the CDPH/EHLB Standard Method v1.1 within the laboratory scope of accreditation to ISO/IEC 17025 and certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	**1** **8 Max**	0	0			
9 F					**(Points are awarded for every 10% of conditioned floor space using one of the below materials.)**				actual %:		
9 F			**(1)**		Hard surface flooring: Prefinished installed hard-surface flooring is installed. Where post-manufacture coatings or surface applications have not been applied, the following hard surface flooring types are deemed to comply with the emission requirements of this practice:						need flooring product spec
9 F				**(a)**	Ceramic tile flooring						
9 F				**(b)**	Organic-free, mineral-based flooring						
9 F				**(c)**	Clay masonry flooring						
9 F				**(d)**	Concrete masonry flooring						
9 F				**(e)**	Concrete flooring						
9 F				**(f)**	Metal flooring				actual %'s:		
9 F			**(2)**		Carpet meeting and carpet cushion not meeting the emission limits is installed.						None
9 F			**(3)**		Carpet and carpet cushion meeting the emission limits is installed.						
9 F					**(When carpet cushion meeting the emission limits of the practice is also installed, the percentage of compliant carpet area is calculated at 1.33 times the actual installed area.)**						
9 F		**901.8**			**901.8 Wall coverings.** A minimum of 10 percent of the interior wall surfaces are covered and a minimum of 85 percent of wall coverings are in accordance with the emission concentration limits of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	**4**	0	0	☐		None

9	F			to, those in Appendix B.								
9 P	F	901.9		**901.9 Interior architectural coatings.** A minimum of 85 percent of the interior architectural coatings are in accordance with either Section 901.9.1 or Section 901.9.3, not both. A minimum of 85 percent of architectural colorants are in accordance with Section 901.9.2.								None
9 P	F	901.9.1		**901.9.1** Site-applied interior architectural coatings, which are inside the water proofing envelope, are in accordance with one or more of the following:	5	5	0					
9 P	F		(1)	Zero VOC as determined by EPA Method 24 (VOC content is below the detection limit for the method)				☐				None
9 P	F		(2)	GreenSeal GS-11				☐				None
9 P	F		(3)	CARB *Suggested Control Measure for Architectural Coatings* (see Table 901.9.1).				☐				None
9 P	F			See Table 901.9.1								
9	F	901.9.2		**901.9.2** Architectural coating colorant additive VOC content is in accordance with Table 901.9.2. **(Points for 901.9.2 are awarded only if base architectural coating is in accordance with 901.9.1.)**	1	0	0	☐				None
				See Table 901.9.2								
9	F	901.9.3		**901.9.3** Site-applied interior architectural coatings, which are inside the waterproofing envelope, are in accordance with the emission levels of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 in its scope of accreditation. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those found in Appendix B.	8	0	0	☐				None
9 P	F	901.10		**901.10 Interior adhesives and sealants.** A minimum of 85 percent of site-applied adhesives and sealants located inside the waterproofing envelope are in accordance with one of the following, as applicable.		5	0					
9 P	F		(1)	The emission levels are in accordance with CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those found in Appendix B.	8			☐				None
9 P	F		(2)	GreenSeal GS-36.	5			☐				None
9 P	F		(3)	SCAQMD Rule 1168 in accordance with Table 901.10(3), excluding products that are sold in 16 ounce containers or less and are regulated by the California Air Resources Board (CARB) Consumer Products Regulations.	5			☐				None
9 P	F			See Table 901.10(3)								
9 P	RF	901.11		**901.11 Insulation.** Emissions of 85 percent of wall, ceiling, and floor insulation materials are in accordance with the emission levels of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation. Insulation is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	4	4	0	☐				None
9	RF	901.12		**901.12 Furniture and Furnishings.** In a multifamily building, all furniture in common areas shall have VOC emission levels in accordance with ANSI/BIFMA e3-Furniture Sustainability Standard sections 7.6.1 and 7.6.2, tested in accordance with ANSI/BIFMA Standard Method M7.1.	2	0	0	☐				None
9 P	F	901.13		**901.13 Carbon monoxide (CO) alarms.** A carbon monoxide (CO) alarm is provided in accordance with the IRC Section R315.	Mandatory							None
9	F	901.14		**901.14 Building entrance pollutants control.** Pollutants are controlled at all main building entrances by one of the following methods:		0	0					None
9	F		(1)	Exterior grilles or mats are installed in a fixed manner and may be removable for cleaning.	1			☐				
9	F		(2)	Interior grilles or mats are installed in a fixed manner and may be removable for cleaning.	1			☐				
9	F	901.15		**901.15 Non-smoking areas.** Environmental tobacco smoke is minimized by one or more of the following:								
9	F		(1)	All interior common areas of a multifamily building are designated as non-smoking areas with posted signage.	1	0	0	☐				None
9	F		(2)	Exterior smoking areas of a multifamily building are designated with posted signage and located a minimum of 25 feet from entries, outdoor air intakes, and operable windows.	1	0	0	☐				None
9 P	RF	902 POLLUTANT CONTROL										
9		902.0		**902.0 Intent.** Pollutants generated in the building are controlled.								
9 P	F	902.1		**902.1 Spot ventilation.**								
9 P	F	902.1.1		**902.1.1** Spot ventilation is in accordance with the following:								
9 P	F		(1)	Bathrooms are vented to the outdoors. The minimum ventilation rate is 50 cfm (23.6 L/s) for intermittent operation or 20 cfm (9.4 L/s) for continuous operation in bathrooms.	Mandatory							None
9	F		(a)	A window complying with IRC Section R303.3 is provided in addition to mechanical ventilation.	1	0	0	☐				None
9 P	F		(2)	Clothes dryers (except listed and labeled condensing ductless dryers) are vented to the outdoors.	Mandatory							None
9	F		(3)	Kitchen exhaust units and/or range hoods are ducted to the outdoors and have a minimum ventilation rate of 100 cfm (47.2 L/s) for intermittent operation or 25 cfm (11.8 L/s) for continuous operation.	8	0	0	☐				None
9	F	902.1.2		**902.1.2** Bathroom and/or laundry exhaust fan is provided with an automatic timer and/or humidistat:	11 Max	0	0	# of timers:				None
9	F		(1)	for first device	5			# of humidistats:				
9	F		(2)	for each additional device	2							
9	F	902.1.3		**902.1.3** Kitchen range, bathroom, and laundry exhaust are verified to air flow specification. Ventilation airflow at the point of exhaust is tested to a minimum of:	8	0	0	☐				None
9	F		(a)	100 cfm (47.2 L/s) intermittent or 25 cfm (11.8 L/s) continuous for kitchens, and								
9	F		(b)	50 cfm (23.6 L/s) intermittent or 20 cfm (9.4 L/s) continuous for bathrooms and/or laundry								
9 P	F	902.1.4		**902.1.4** Exhaust fans are ENERGY STAR, as applicable.	12 Max	3	0					Panasonic ES fan, low sone per Mech Engineer
9 P	F		(1)	ENERGY STAR, or equivalent, fans operating above 1 sone **(Points awarded per fan.)**	2			# of fans:				
9 P	F		(2)	ENERGY STAR, or equivalent, fans operating at or below 1 sone **(Points awarded per fan.)**	3							
9	F	902.1.5		**902.1.5** Fenestration in spaces other than those identified in 902.1.1 through 902.1.4 are designed for stack effect or cross-ventilation in accordance with all of the following:	3	0	0					
9	F		(1)	Operable windows, operable skylights, or sliding glass doors with a total area of at least 15 percent of the total conditioned floor area are provided.				☐				None
9	F		(2)	Insect screens are provided for all operable windows, operable skylights, and sliding glass doors.				☐				None
9	F		(3)	A minimum of two operable windows or sliding glass doors are placed in adjacent or opposite walls. If there is only one wall surface in that space exposed to the exterior, the minimum windows or sliding glass doors may be on the same wall.				☐				None
9	F	902.1.6		**902.1.6 Ventilation for Multifamily Common Spaces.** Systems are implemented and are in accordance with the specifications of ASHRAE 62.1 and an explanation of the operation and importance of the ventilation system is included in 1002.1 and 1002.2 of NGBS.	3	0	0	☐				None
9 P	F	902.2		**902.2 Building ventilation systems.**								
9 P	F	902.2.1		**902.2.1** One of the following whole building ventilation systems is implemented and is in accordance with the specifications of ASHRAE Standard 62.2-2010 Section 4 and an explanation of the operation and importance of the ventilation system is **included in either 1001.1(9) or 1002.2(11)**.	N/A	0	0					May need smart switchs on the bath fans if following NGBS prescriptive path. Currently following the ERI path and not required if the unit ACH is 5 or great
9 P	F		(1)	exhaust or supply fan(s) ready for continuous operation and with appropriately labeled controls	3							
9 P	F		(2)	balanced exhaust and supply fans with supply intakes located in accordance with the manufacturer's guidelines so as to not introduce polluted air back into the building	6							
9 P	F		(3)	heat-recovery ventilator	7							
9 P	F		(4)	energy-recovery ventilator	8							
9 P	F		(5)	Ventilation air is preconditioned by a system not specified above	10							
9	F	902.2.2		**902.2.2** Ventilation airflow is tested to achieve the design fan airflow in accordance with ANSI/RESNET/ICC 380 and Section 902.2.1.	4	0	0	☐				None
9	F	902.2.3		**902.2.3** MERV filters 8 to 13 are installed on central forced air systems and are accessible. Designer or installer is to verify that the HVAC equipment is able to accommodate the greater pressure drop of MERV 8 to 13 filters.	2	0	0	☐				None
9	F	902.2.4		**902.2.4** MERV filters 14 or greater are installed on central forced air systems and are accessible. Designer or installer is to verify that the HVAC equipment is able to accommodate the greater pressure drop of the filter used.	3	0	0	☐				None
9 P	RF	902.3		**902.3 Radon reduction measures.** Radon reduction measures are in accordance with ICC IRC								At minimum a passive radon system

9	P	RF			Appendix F or 902.3.1. Radon Zones as identified by the AHJ or, if the zone is not identified by the AHJ, as defined in Figure 9(1).	Mandatory						needs to be installed. A select number of units will need to be tested and if radon is found above 4 pCi/L the system will need to be activated.
9	P	RF		(1)	Buildings located in Zone 1		0	0					
9	P	RF		(a)	a passive radon system is installed	N/A							
9	P	RF		(b)	an active radon system is installed	12							
9	P	RF		(2)	Buildings located in Zone 2 or Zone 3		0	0					
9	P	RF		(a)	a passive radon system is installed	6							
9	P	RF		(b)	an active radon system is installed	12							
9	P	RF	902.3.1		**902.3.1 Radon reduction option.** This option requires section 902.3.2.1 through 902.3.2.7.								
9	P	RF	902.3.1.1		**902.3.1.1 Soil-gas barriers and base course.** A base course in accordance with Section 506.2.2 of the IRC shall be installed below slabs and foundations. There shall be a continuous gas-permeable base course under each soil-gas retarder that is separated by foundation walls or footings. Between slabs and the base course, damp proofing or water proofing shall be installed in accordance with Section 406 of the IRC. Punctures, tears and gaps around penetrations of the soil-gas retarder shall be repaired or covered with an additional soil-gas retarder. The soil-gas retarder shall be a continuous6-mil (0.15 mm) polyethylene or an approved equivalent.								
9	P	RF	902.3.1.2		**902.3.1.2 Soil gas collection.** There shall be an unobstructed path for soil gas flow between the void space installed in the base course and the vent through the roof. Soil gases below the foundation shall be collected by a perforated pipe with a diameter of not less than 4 inches (10 cm) and not less than 5 feet (1.5 m) in total length. A tee fitting or equivalent method shall provide two horizontal openings to the radon collection. The tee fitting shall be designed to prevent clogging of the radon collection path. Alternately the soil gas collection shall be by approved radon collection mats or an equivalent approved method.								
9	P	RF	902.3.1.3		**902.3.1.3 Soil gas entry routes.** Openings in slabs, soil-gas retarders, and joints such as, but not limited to, plumbing, ground water control systems, soil-gas vent pipes, piping and structural supports, shall be sealed against air leakage at the penetrations. The sealant shall be a polyurethane caulk, expanding foam or other approved method. Foundation walls shall comply with Section 103.2.3 of the IRC. Sumps shall be sealed in accordance with Section 103.2.2 of the IRC. Sump pits and sump lids intended for ground water control shall not be connected to the sub-slab soil-gas exhaust system.								
9	P	RF	902.3.1.4		**902.3.1.4 Soil gas vent.** A gas-tight pipe vent shall extend from the soil gas permeable layer though the roof. The vent pipe size shall not be reduced at any location as it goes from gas collection to the roof. Exposed and visible interior vent pipes shall be identified with not less than one label reading "Radon Reduction System" on each floor and in habitable attics.								
9	P	RF	902.3.1.5		**902.3.1.5 Vent pipe diameter.** The minimum vent pipe diameter shall be as specified in Table 902.3.2.5.								
9	P	RF	902.3.1.6		**902.3.1.6 Multiple vented areas.** In dwellings where interior footings or other barriers separate the soil-gas permeable layer, each area shall be fitted with an individual vent pipe. Vent pipes shall connect to a single vent that terminates above the roof or each individual vent pipe shall terminate separately above the roof.								
9	P	RF	902.3.1.7		**902.3.1.7 Fan.** Each sub-slab soil-gas exhaust system shall include a fan, or dedicated space for the post-construction installation of a fan. The electrical supply for the fan shall be located within 6 feet (1.8 m) of the fan. Fan is not required to be on a dedicated circuit.								
9	P	RF	902.3.2		**902.3.2 Radon testing.** Radon testing is mandatory for Zone 1.	N/A							
9	P	RF			**Exceptions:**				Exception:				
9	P	RF			(2) Testing is not mandatory where the occupied space is located above an unenclosed open space.				☐				
9	P	RF		(1)	Testing specifications. Testing is performance as specified in (a) through (j).	8	8	0	☐				3 pCi/L used as a place holder
9	P	RF		(a)	Testing is performed after the residence passes its airtightness test.				Test results (pCi/L):				
9	P	RF		(b)	Testing is performed after the radon control system installation is complete. If the system has an active fan, the residence shall be tested with the fan operating.								
9	P	RF		(c)	Testing is performed at the lowest level within a dwelling unit which will be occupied, even if the space is not finished.								
9	P	RF		(d)	Testing is not performed in a closet, hallway, stairway, laundry room, furnace room, kitchen or bathroom.								
9	P	RF		(e)	Testing is performed with a commercially available test kit or with a continuous radon monitor that can be calibrated. Testing shall be in accordance with the testing device manufacturer's instructions.								
9	P	RF		(f)	Testing shall be performed by the builder, a registered design professional, or an approved third party.								
9	P	RF		(g)	Testing shall extend at least 48 hours or to the minimum specified by the manufacturer, which ever is longer.								
9	P	RF		(h)	Written radon test results shall be provided by the test lab or testing party. Written test results shall be included with construction documents.								
9	P	RF		(i)	An additional pre-paid test kit shall be provided for the homeowner to use when they choose. The test kit shall include mailing or emailing the results from the testing lab to the homeowner.								
9	P	RF		(j)	Where the radon test result is 4 pCi/L or greater, the fan for the radon vent pipe shall be installed.								
9	P	RF		(2)	Testing results. A radon test done in accordance with 902.3.1 and completed before occupancy receives a results of 2 pCi/L or less.	6	0	0					None
9	P	RF	902.4		**902.4 HVAC system protection.** One of the following HVAC system protection measures is performed.	3	3	0					
9	P	R		(1)	HVAC supply registers (boots), return grilles, and rough-ins are covered during construction activities to prevent dust and other pollutants from entering the system.				☐				None
9	P	F		(2)	Prior to owner occupancy, HVAC supply registers (boots), return grilles, and duct terminations are inspected and vacuumed. In addition, the coils are inspected and cleaned and the filter is replaced if necessary.				☐				None
9	P	F		(3)	If HVAC systems are to be operated, during construction, all return grilles have a temporary MERV 8 or higher filter installed in a manner ensuring no leakage around the filter.				☐				None
9		RF	902.5		**902.5 Central vacuum systems.** Central vacuum system is installed and vented to the outside.	3	0	0	☐				None
9	P	R	902.6		**902.6 Living space contaminants.** The living space is sealed in accordance with Section 701.4.3.1 to prevent unwanted contaminants.	Mandatory			☐				None
9	P	RF	903 MOISTURE MANAGEMENT: VAPOR, RAINWATER, PLUMBING, HVAC										
9			903.0		**903.0 Intent.** Moisture and moisture effects are controlled.								
9	P	R	903.1		**903.1 Plumbing.** Plumbing is in accordance with one of the following.		2	0					None
9	P	R		(1)	Cold water pipes in unconditioned spaces are insulated to a minimum of R-4 with pipe insulation or other covering that adequately prevents condensation.	2							
9	P	R		(2)	Plumbing is not installed in unconditioned spaces.	5							
9		RF	903.2		**903.2 Duct insulation.** Ducts are in accordance with one of the following.		0	0					None
9		RF		(1)	All HVAC ducts, plenums, and trunks are located in conditioned space.	1							
9		RF		(2)	All HVAC ducts, plenums, and trunks are in conditioned space. All HVAC ducts are insulated to a minimum of R4.	3							
9		F	903.3		**903.3 Relative humidity.** In climate zones 1A, 2A, 3A, 4A, and 5A, equipment is installed to maintain relative humidity (RH) at or below 60 percent using one of the following:	7	0	0					None
9		F		(1)	additional dehumidification system(s)				☐				
9		F		(2)	central HVAC system equipped with additional controls to operate in dehumidification mode				☐				
9	P	RF	904 INDOOR AIR QUALITY										
9			904.0		**904.0 Intent.** IAQ is protected by best practices to control ventilation, moisture, pollutant sources and sanitation.								
9	P	R	904.1		**904.1 Indoor Air Quality (IAQ) During Construction.** Wood is dry before close-in (602.1.7.1(3)), materials comply with emission criteria (901.4- 901.11), sources of water infiltration or condensation observed during construction have been eliminated, accessible interior surfaces are dry and free of visible suspect growth (per ASTM D7338-10 section 6.3), and water damage (per ASTM D7338-10 section 7.4.3).	2	2	0	☐				None
9	P	F	904.2		**904.2 Indoor Air Quality (IAQ) Post Completion.** Verify there are no moisture, mold, and dust issues per 602.1.7.1(3), 901.4-901.11, ASTM D7338 Section 6.3, and ASTM D7338 Section 7.4.3.	3	3	0	☐				None
9	P	R	904.3		**904.3 Microbial growth & moisture inspection and remediation.** A visual inspection is performed to confirm the following:								

9	P	R		(1)	Verify that no visible signs of discoloration and microbial growth on ceilings, walls or floors, or other building assemblies Or If minor microbial growth is observed (less than within a total area of 25 square feet) in homes or multifamily buildings, reference EPA Document 402-K-02-003 (A Brief Guide to Mold, Moisture, and Your Home) for guidance on how to properly remediate the issue. If microbial growth is observed, on a larger scale in homes or multifamily buildings (greater than 25 sq ft), reference EPA document 402-k-01-001 (Mold Remediation in Schools and Commercial Buildings) for guidance on how to properly remediate the issue.	**Mandatory**			☐		None
9	P	R		(2)	Verify that there are no visible signs of water damage or pooling. If signs of water damage or pooling are observed, verify that the source of the leak has been repaired, and that damaged materials are either properly dried or replaced as needed.	**Mandatory**			☐		None
9	P	RF	905 INNOVATIVE PRACTICES									
9		F	**905.1**		**905.1 Humidity monitoring system.** A humidity monitoring system is installed with a mobile base unit that displays readings of temperature and relative humidity. The system has a minimum of two remote sensor units. One remote sensor unit is placed permanently inside the conditioned space in a central location, excluding attachment to exterior walls, and another remote sensor unit is placed permanently outside of the conditioned space.	**2**	0	0	☐		None
9		F	**905.2**		**905.2 Kitchen exhaust.** A kitchen exhaust unit(s) that equals or exceeds 400 cfm (189 L/s) is installed, and makeup air is provided.	**2**	0	0	☐		None
9		F	**905.3**		**905.3 Enhanced air filtration.** Meet all of the following.	**2**	0	0			
9		F		**(1)**	Design for and install a secondary filter rack space for activated carbon filters.				☐		None
9		F		**(2)**	Provide the manufacturer's recommended filter maintenance schedule to the homeowner or building manager.				☐		None
9		F	**905.4**		**905.4 Sound barrier.** Provide room-to-room privacy between bedrooms and adjacent living spaces within dwelling units or homes by achieving an articulation index (AI) between 0 and 0.15 per the criteria below. *Articulation Index 0 to 0.05 = STC greater than 55 (NIC greater than 47)* *Articulation Index 0.05 to 0.15 = STC 52 to 55 (NIC 44 to 47)*	**1 SF / 4 MF**	0	0	☐		None
9		F	**905.5**		**905.5 Evaporative coil mold prevention.** For buildings with a mechanical system for cooling, ultraviolet lamps are installed on the cooling coils and drain pans of the mechanical system supplies. Lamps produce ultraviolet radiation at a wavelength of 254 nm so as not to generate ozone. Lamps have ballasts housed in a NEMA-rated enclosure.	**2**	0	0	☐		None

1001 HOMEOWNER'S MANUAL AND TRAINING GUIDELINES FOR ONE- AND TWO-FAMILY DWELLINGS

1001.0 **1001.0 Intent.** Information on the building's use, maintenance, and green components is provided.

1001.1		**1001.1** A homeowner's manual is provided and stored in a permanent location in the dwelling that includes the following, as available and applicable.	**1 8 Max**	0	0			
		(Points awarded per two items. Points awarded for non-mandatory items.)						
	(1)	A National Green Building Standard certificate with weblink and completion document.	N/A			☐		None
	(2)	List of green building features (can include the national green building checklist).	N/A			☐		None
	(3)	Product manufacturer's manuals or product data sheet for installed major equipment, fixtures, and appliances. If product data sheet is in the building owners' manual, manufacturer's manual may be attached to the appliance in lieu of inclusion in the building owners' manual.	N/A			☐		None
	(4)	Maintenance checklist.				☐		None
	(5)	Information on local recycling and composting programs.				☐		None
	(6)	Information on available local utility programs that purchase a portion of energy from renewable energy providers.				☐		None
	(7)	Explanation of the benefits of using energy-efficient lighting systems [e.g., compact fluorescent light bulbs, light emitting diode (LED)] in high-usage areas.				☐		None
	(8)	A list of practices to conserve water and energy.				☐		None
	(9)	Information on the importance and operation of the home's fresh air ventilation system.	N/A			☐		None
	(10)	Local public transportation options.				☐		None
	(11)	A diagram showing the location of safety valves and controls for major building systems.				☐		None
	(12)	Where frost-protected shallow foundations are used, owner is informed of precautions including:				☐		None
	(a)	instructions to not remove or damage insulation when modifying landscaping.						
	(b)	providing heat to the building as required by the ICC IRC or IBC.						
	(c)	keeping base materials beneath and around the building free from moisture caused by broken water pipes or other water sources.						
	(13)	A list of local service providers that offer regularly scheduled service and maintenance contracts to ensure proper performance of equipment and the structure (e.g., HVAC, water-heating equipment, sealants, caulks, gutter and downspout system, shower and/or tub surrounds, irrigation system).				☐		None
	(14)	A photo record of framing with utilities installed. Photos are taken prior to installing insulation, clearly labeled, and included as part of the building owners' manual.				☐		None
	(15)	List of common hazardous materials often used around the building and instructions for proper handling and disposal of these materials.				☐		None
	(16)	Information on organic pest control, fertilizers, deicers, and cleaning products.				☐		None
	(17)	Information on native landscape materials and/or those that have low water requirements.				☐		None
	(18)	Information on methods of maintaining the building's relative humidity in the range of 30 percent to 60 percent.				☐		None
	(19)	Instructions for inspecting the building for termite infestation.				☐		None
	(20)	Instructions for maintaining gutters and downspouts and importance of diverting water a minimum of 5 feet away from foundation.				☐		None
	(21)	A narrative detailing the importance of maintenance and operation in retaining the attributes of a green-built building.				☐		None
	(22)	Where stormwater management measures are installed on the lot, information on the location, purpose, and upkeep of these measures.				☐		None
	(23)	Explanation of and benefits from green cleaning in the home.				☐		None
	(24)	Retrofit energy calculator that provides baseline for future energy retrofits.				☐		None
1001.2		**1001. 2 Training of initial homeowners.** Initial homeowners are familiarized with the role of occupants in achieving green goals. Training is provided to the responsible party(ies) regarding equipment operation and maintenance, control systems, and occupant actions that will improve the environmental performance of the building. These include:	N/A 8	0	0	☐		None
	(1)	HVAC filters.						
	(2)	Thermostat operation and programming.						
	(3)	Lighting controls.						
	(4)	Appliances operation.						
	(5)	Water heater settings and hot water use.						
	(6)	Fan controls.						
	(7)	Recycling and composting practices.						
	(8)	Whole-dwelling mechanical ventilation systems.						

1002 CONSTRUCTION, OPERATION, AND MAINTENANCE MANUALS AND TRAINING FOR MULTI-UNIT BUILDINGS

1002.0 **1002.0 Intent.** Manuals are provided to the responsible parties (owner, management, tenant, and/or maintenance team) regarding the construction, operation, and maintenance of the building. Paper or digital format manuals are to include information regarding those aspects of the building's construction, maintenance, and operation that are within the area of responsibilities of the respective recipient. One or more responsible parties are to receive a copy of all documentation for archival purposes.

1002.1		**1002.1 Building construction manual.** A building construction manual, including five or more of the following, is compiled and distributed in accordance with Section 1002.0.	**1**	2	0			
		(Points awarded per two items. Points awarded for non-mandatory items.)						
	(1)	A narrative detailing the importance of constructing a green building, including a list of green building attributes included in the building. This narrative is included in all responsible parties' manuals.	Mandatory			☐		None
	(2)	A local green building program certificate as well as a copy of the *National Green Building Standard* ™, as adopted by the Adopting Entity, and the individual measures achieved by the building.	Mandatory			☐		None
	(3)	Warranty, operation, and maintenance instructions for all equipment, fixtures, appliances, and finishes.	Mandatory			☐		None
	(4)	Record drawings of the building.				☐		None
	(5)	A record drawing of the site including stormwater management plans, utility lines, landscaping with common name and genus/species of plantings.				☐		None
	(6)	A diagram showing the location of safety valves and controls for major building systems.				☐		None
	(7)	A list of the type and wattage of light bulbs installed in light fixtures.				☐		None
	(8)	A photo record of framing with utilities installed. Photos are taken prior to installing insulation and clearly labeled.				☐		None
1002.2		**1002.2 Operations manual.** Operations manuals are created and distributed to the responsible parties in accordance with Section 1002.0. Between all of the operation manuals, five or more of the following options are included.	**1**	2	0			
		(Points awarded per two items. Points awarded for non-mandatory items.)						
	(1)	A narrative detailing the importance of operating and living in a green building. This narrative is included in all responsible parties' manuals.	Mandatory			☐		None
	(2)	A list of practices to conserve water and energy (e.g., turning off lights when not in use, switching the rotation of ceiling fans in changing seasons, purchasing ENERGY STAR appliances and electronics).	Mandatory			☐		None
	(3)	Information on methods of maintaining the building's relative humidity in the range of 30 percent to 60 percent.				☐		None
	(4)	Information on opportunities to purchase renewable energy from local utilities or national green power providers and information on utility and tax incentives for the installation of on-site renewable energy systems.				☐		None
	(5)	Information on local and on-site recycling and hazardous waste disposal programs and, if applicable, building recycling and hazardous waste handling and disposal procedures.				☐		None
	(6)	Local public transportation options.				☐		None
	(7)	Explanation of the benefits of using compact fluorescent light bulbs, LEDs, or other high-efficiency lighting.				☐		None
	(8)	Information on native landscape materials and/or those that have low water requirements.				☐		None
	(9)	Information on the radon mitigation system, where applicable.				☐		None
	(10)	A procedure for educating tenants in rental properties on the proper use, benefits, and maintenance of green building systems including a maintenance staff notification process for improperly functioning equipment.				☐		None
	(11)	Information on the importance and operation of the building's fresh air ventilation system.	N/A			☐		None

10 P F	1002.3		**1002.3 Maintenance manual.** Maintenance manuals are created and distributed to the responsible parties in accordance with Section 1002.0. Between all of the maintenance manuals, five or more of the following options are included.	1	2	0			
10 P F			**(Points awarded per two items. Points awarded for non-mandatory items.)**						
10 P F		(1)	A narrative detailing the importance of maintaining a green building. This narrative is included in all responsible parties' manuals.	Mandatory			☐		None
10 P F		(2)	A list of local service providers that offer regularly scheduled service and maintenance contracts to ensure proper performance of equipment and the structure (e.g., HVAC, water-heating equipment, sealants, caulks, gutter and downspout system, shower and/or tub surrounds, irrigation system).				☐		None
10 P F		(3)	User-friendly maintenance checklist that includes:				☐		None
10 P F		(a)	HVAC filters						
10 P F		(b)	thermostat operation and programming						
10 P F		(c)	lighting controls						
10 P F		(d)	appliances and settings						
10 P F		(e)	water heater settings						
10 P F		(f)	fan controls						
10 P F		(4)	List of common hazardous materials often used around the building and instructions for proper handling and disposal of these materials.				☐		None
10 P F		(5)	Information on organic pest control, fertilizers, deicers, and cleaning products.				☐		None
10 P F		(6)	Instructions for maintaining gutters and downspouts and the importance of diverting water a minimum of 5 feet away from foundation.				☐		None
10 P F		(7)	Instructions for inspecting the building for termite infestation.				☐		None
10 P F		(8)	A procedure for rental tenant occupancy turnover that preserves the green features.				☐		None
10 P F		(9)	An outline of a formal green building training program for maintenance staff.				☐		None
10 P F		(10)	A green cleaning plan which includes guidance on sustainable cleaning products.				☐		None
10 P F		(11)	A maintenance plan for active recreation and play spaces (e.g., playgrounds, ground markings, exercise equipment.				☐		None
10 P F	1002.4		**1002.4 Training of building owners.** Building owners are familiarized with the role of occupants in achieving green goals. On-site training is provided to the responsible party(ies) regarding equipment operation and maintenance, control systems, and occupant actions that will improve the environmental performance of the building. These include:	Mandatory 8	8	0	☐		None
10 P F		(1)	HVAC filters						
10 P F		(2)	thermostat operation and programming						
10 P F		(3)	lighting controls						
10 P F		(4)	appliances operation						
10 P F		(5)	water heater settings and hot water use						
10 P F		(6)	fan controls						
10 P F		(7)	recycling and composting practices						
10 P F		(8)	Whole-dwelling mechanical ventilation systems						
10 F	1002.5		**1002.5 Multifamily occupant manual.** An occupant manual is compiled and distributed in accordance with Section 1002.0. *[Points awarded for non-mandatory items.]*	1 per 2 items	0	0			
10 F		(1)	NGBS certificate	Mandatory			☐		None
10 F		(2)	List of green building features	Mandatory			☐		None
10 F		(3)	Operations manuals for all appliances and occupant operated equipment including lighting and ventilation controls, thermostats, etc.	Mandatory			☐		None
10 F		(4)	Information on recycling and composting programs				☐		None
10 F		(5)	Information on purchasing renewable energy from utility				☐		None
10 F		(6)	Information on energy efficient replacement lamps				☐		None
10 F		(7)	List of practices to save water and energy				☐		None
10 F		(8)	Local public transportation options				☐		None
10 F		(9)	Explanation of benefits of green cleaning				☐		None
10 P F	1002.6		**1002.6 Training of multifamily occupants.** Prepare a training outline, video or website that familiarizes occupants with their role in maintaining the green goals of the project. Include all equipment that the occupant(s) is expected to operate including but not limited.	1 per 2 items	1	0			
10 P F		(1)	Lighting controls				☐		None
10 P F		(2)	Ventilation controls				☐		None
10 P F		(3)	Thermostat operation and programming				☐		None
10 P F		(4)	Appliances operation				☐		None
10 P F		(5)	Recycling and composting				☐		None
10 P F		(6)	HVAC filters				☐		None
10 P F		(7)	Water heater setting and hot water use				☐		None
10 P RF	**1003 PUBLIC EDUCATION**								
10	1003.0		**1003.0 Intent.** Increase public awareness of the National Green Building Standard and projects constructed in accordance with National Green Building Standard to help increase demand for high-performance homes.						
10 P RF	1003.1		**1003.1 Public Education.** One or more of the following is implemented:	2 Max	1	0			
10 P R		(1)	**Signage.** Signs showing the project is designed and built in accordance with the National Green Building Standard are posted on the construction site.	1			☐		None
10 P F		(2)	**Certification Plaques.** National Green Building Standard certification plaques with rating level attainted are placed in a conspicuous location near the utility area of the home or, in a conspicuous location near the main entrance of a multifamily building.	1			☐		None
10 P R		(3)	**Education.** A URL for the National Green Building Standard is included on site signage, builder website (or property website for multifamily buildings), and marketing materials for homes certified under the National Green Building Standard.	1			☐		None
10 P RF	**1004 POST OCCUPANCY PERFORMANCE ASSESSMENT**								
10	1004.0		**1004.0 Intent.** A verification system for post occupancy assessment of the building is intended to be a management tool for the building owner to determine if energy or water usage have deviated from expected levels so that inspection and correction action can be taken.						
10 F	1004.1		**1004.1** A verification system plan is provided in the building owner's manual (Sections 1001 or 1002). The verification system provides methods for demonstrating continued energy and water savings that are determined from the building's initial year of occupancy of water and energy consumption as compared to annualized consumption at least every four years.						
10 F		(1)	Verification plan is developed to monitor post-occupancy energy and water use and is provided in the building owner's manual.	1	0	0	☐		None
10 F		(2)	Verification system is installed in the building to monitor post-occupancy energy and water use.	3	0	0	☐		None
10 P RF	**1005 INNOVATIVE PRACTICES**								
10 P F	1005.1		**1005.1 Appraisals.** One or more of the following is implemented:						
10 F		(1)	Energy rating or projected usage data is posted in an appropriate location in the home, or public posting so that an appraiser can access the energy data for an energy efficiency property valuation.	2	0	0	☐		None
10 F		(2)	An Appraisal Institute Form 820.05 "Residential Green and Energy Addendum" or Form 821 "Commercial Green and energy Efficient Addendum" that consider NGBS, LEED, ENERGY STAR certifications and equivalent programs, is completed for the appraiser by a qualified professional or builder to use in performing the valuation of the property.	2	0	0	☐		None
10 P F		(3)	NGBS certification information or one of the Appraisal Institute Forms cited in (2) above is uploaded to a multiple listing service (MLS) or equivalent database so that appraisers can access it to compare property valuations.	2	2	2	Home Innovation makes key certification details available, but MLS organizations need to take affirmative action to ensure data is received and made publicly available. Contact us for more details.		

Filters

F/C&S R/F

Select a path

NGBS GREEN
Home Innovation Research Labs

Mandatory Information is missing on the Overview (Verification) page!
There is mandatory information or practices missing from this Page!

Version: 5.2.20
Report Phase:
Rev. Date: 2/28/2024
Home Address:
Community/Lot #:

F/C&S	R/F	Practice #		Practice	Points Available			Status	Verifier Notes
CS	RF	CHAPTER 13: COMMERCIAL SPACES NEW CONSTRUCTION							
CS		**13.101.1**		**13.101.1 Intent.** This chapter shall provide green requirements for the non-residential portion(s) of a mixed-use building.					
CS		**13.101.2**		**13.101.2 Scope.** The provisions of this Chapter shall apply to the design, construction, addition, and alteration of non-residential portion(s) of a mixed-use building.					
CS	R	**13.102.1**		**13.102.1 Compliance.** The non-residential portion(s) of a mixed-use building shall comply with all of the provisions of this chapter as applicable. The provisions of this Chapter are mandatory.	Mandatory				
CS	R	**13.102.1.1**		**13.102.1.1 Core and shell compliance.** The exterior air barrier, insulation, air sealing, and fenestration, are verified to the requirements of this chapter at the time of certification.					
CS	R	**13.102.1.2**		**13.102.1.2 Full mixed-use building compliance.** Residential and non-residential spaces are verified to the requirements of this standard at the time of certification. The residential portions of the building are verified to the requirements of Chapters 5 through 10 of this standard. The non-residential portion(s) of the building must comply with the requirements of this chapter.					
CS	R	**13.102.1.3**		**13.102.1.3 Additions and alterations.** The provisions of this Chapter shall only apply to areas of the building that are exposed or created during the remodel of mixed-use building(s) complying with Section 305, Green Remodeling.					
F	RF	**13.103.1**		**13.103.1 Bicycle parking.** Bicycle parking shall comply with section 103.1.1 through 103.1.2					
F	RF	**13.103.1.1**		**13.103.1.1 Minimum number of spaces.** The minimum number of required bicycle parking spaces shall be 4 parking spaces.	N/A			☐	
F	RF			**Exceptions:**					
F	RF		**(1)**	The number of bicycle parking spaces shall be allowed to be reduced subject to Adopting Entity approval,	N/A			☐	
F	RF		**(2)**	Bicycle parking shall not be required where the total non-residential conditioned space in the building is less than 1,000 square feet.	N/A			☐	
F	RF		**(3)**	The minimum number of spaces shall be permitted to be reduced by the authority having jurisdiction based on the occupants expected use of public transit or walking to the building.	N/A			☐	
F	RF	**13.103.1.2**		**13.103.1.2 Location.** The bicycle parking must be located on the same building site or within the building. It must be located within 100 ft. of, and visible from the main entrance.	N/A			☐	
F	RF	**13.104**		**13.104 Resource Efficiency.**					
F	RF	**13.104.1**		**13.104.1 Enhanced Durability.**					
F	R	**13.104.1.1**		**13.104.1.1 Capillary Break.** A capillary break and vapor retarder shall be installed under the concrete slabs in accordance with ICC IBC Sections 1907, excluding exception #3 and 1805.2.1.	N/A				
F	R	**13.104.1.2**		**13.104.1.2 Foundation drainage.** Where required by the ICC IBC for habitable and usable spaces below grade, exterior drain tile is installed.	N/A				
F	R	**13.104.1.3**		**13.104.1.3 Dampproof walls.** Walls that retain earth, and encloses interior space are required to be dampproof per ICC IBC Section 1805.	N/A				
F	R	**13.104.1.4**		**13.104.1.4 Water-resistive barrier.** Where required by the ICC IBC, a water-resistive barrier and/or drainage plane system is installed behind exterior cladding.	N/A				
F	R			Note: Explain N/A					
F	R	**13.104.1.5**		**13.104.1.5 Flashing.** Flashing is provided as follows to minimize water entry into wall and roof assemblies and to direct water to exterior surfaces or exterior water-resistive barriers for drainage. Flashing details are provided in the construction documents and are in accordance with the fenestration manufacturer's instructions, the flashing manufacturer's instructions, or as detailed by a registered design professional. Flashing is installed at the following locations, as applicable unless in conflict with manufacturer's installation instructions:					
F	R		**(1)**	Around exterior fenestrations, skylights, and doors	N/A				
F	R		**(2)**	At roof valleys	N/A				
F	R		**(3)**	At all building-to-deck, -balcony, -porch, and -stair intersections	N/A				
F	R		**(4)**	At roof-to-wall intersections, at roof-to-chimney intersections, at wall-to-chimney intersections, and at parapets	N/A				
F	R		**(5)**	At ends of and under masonry, wood, or metal copings and sills	N/A				
F	R		**(6)**	Above projecting wood trim	N/A				
F	R		**(7)**	At built-in roof gutters, and	N/A				
F	R		**(8)**	Drip edge is installed at eave and rake edges	N/A				
F	R		**(9)**	Window and door head and jamb flashing is either self-adhered or liquid applied	N/A				
F	R		**(10)**	Flashing is installed at exterior windows and doors	N/A				
F	R		**(11)**	Through-wall flashing is installed at transitions between wall cladding materials or wall construction types	N/A				
F	R		**(12)**	Flashing is installed at the expansion joint in stucco walls	N/A				
F	R	**13.104.1.6**		**13.104.1.6 Tile backing materials.** Tile backing materials installed under tiled surfaces in wet areas are in accordance with ASTM C1178, C1278, C1288, or C1325. Tile shall not be installed over paper-faced gypsum board in wet areas.	N/A				
F	R	**13.104.1.7**		**13.104.1.7 Ice barrier.** In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier is installed in accordance with the ICC IBC at roof eaves of pitched roofs and extends a minimum of 24 inches (610 mm) inside the exterior wall line of the building.	N/A				
F	RF	**13.104.1.8**		**13.104.1.8 Architectural features.** Architectural features that increase the potential for water intrusion are avoided, and must comply with the following:					
F	RF		**(1)**	Horizontal ledgers are sloped away to provide gravity drainage as appropriate for the application.	N/A			☐	
F	RF		**(2)**	No roof configurations that create horizontal valleys in roof design, unless directed to a drain on a flat roof.	N/A			☐	
F	RF		**(3)**	No recessed windows and architectural features that trap water on horizontal surfaces	N/A			☐	
CS	R	**13.104.1.9**		**13.104.1.9 Moisture control measures.** Moisture control measures for newly installed materials are in accordance with the following:					
CS	R		**(1)**	Building materials with visible mold are not installed or are cleaned or encapsulated prior to concealment and closing	Mandatory			☐	
CS	R		**(2)**	Insulation in cavities is dry in accordance with manufacturer's installation instructions when enclosed (e.g., with drywall)	Mandatory			☐	
F	RF	**13.104.2**		**13.104.2 Construction material and waste management plan.** A written construction waste management plan is posted at the jobsite, and implemented.	N/A			☐	

CS R	**13.104.3**		**13.104.3 Core and shell material selection.** The core and shell of the non-residential portion of the building must contain similar green material selections of the residential portion of the building, and must comply with the additional provisions of this section.	**Mandatory**		☐	
F RF	**13.104.3.1**		**13.104.3.1 Material selection.** At least six of these sections must be met from the following:	**N/A**	0 met		
F RF	**606.1**		**606.1 Biobased products.** The following biobased products are used:				
F RF		**(a)**	certified solid wood in accordance with Section 606.2				
F RF		**(b)**	engineered wood				
F RF		**(c)**	bamboo				
F RF		**(d)**	cotton		**Not Met**		
F RF		**(e)**	cork				
F RF		**(f)**	straw				
F RF		**(g)**	natural fiber products made from crops (soy-based, corn-based)				
F RF		**(h)**	other biobased materials with a minimum of 50 percent biobased content (by weight or volume)				
F RF							
F RF			Note: Please list "other biobased materials" used in the Notes field				
F RF		**(1)**	Two types of biobased materials are used, each for more than 0.5 percent of the project's projected building material cost.	**3**			
F RF		**(2)**	Two types of biobased materials are used, each for more than 1 percent of the project's projected building material cost.	**6**			
F RF		**(3)**	For each additional biobased material used for more than 0.5 percent of the project's projected building material cost.	**1 2 Max**			
F RF	**606.2**		**606.2 Wood-based products.** Wood or wood-based products are certified to the requirements of one of the following:		**Not Met**		
F RF		**(a)**	American Forest Foundation's *American Tree Farm System®* (ATFS)				
F RF		**(b)**	Canadian Standards Association's *Sustainable Forest Management System Standards* (CSA Z809)				
F RF		**(c)**	*Forest Stewardship Council* (FSC)				
F RF		**(d)**	*Program for Endorsement of Forest Certification Systems* (PEFC)				
F RF		**(e)**	*Sustainable Forestry Initiative ® Program (SFI)*				
F RF		**(f)**	National Wood Flooring Association's Responsible Procurement Program (RPP)				
F RF		**(g)**	other product programs mutually recognized by PEFC				
F RF		**(h)**	A manufacturer's fiber procurement system that has been audited by an approved agency as compliant with the provisions of ASTM D7612 as a responsible or certified source. Government or tribal forestlands whose water protection programs have been evaluated by an approved agency as compliant with the responsible source designation of ASTM D7612 are exempt from auditing in the manufacturers' fiber procurement system.				
F RF						Program(s):	
F RF		**(1)**	A minimum of two responsible or certified wood-based products are used for minor components of the building.	**3**	0		
F RF			Note: Please list products and components in the Notes fields				
F RF		**(2)**	A minimum of two responsible or certified wood-based products are used in major components of the building.	**4**	0		
F RF			Note: Please list products and components in the Notes fields				
F RF	**606.3**		**606.3 Manufacturing energy.** Materials manufactured using a minimum of 33 percent of the primary manufacturing process energy derived from (1) renewable sources, (2) combustible waste sources, or (3) renewable energy credits (RECs) are used for major components of the building. **(2 points awarded per material.)**	**6 Max**	**Not Met**		
F RF			Note: Please list materials in the Notes field				
F RF	**608.1**		**608.1 Resource-efficient materials.** Products containing fewer materials are used to achieve the same end-use requirements as conventional products, including but not limited to:				
F RF		**(1)**	lighter, thinner brick with bed depth less than 3 inches and/or brick with coring of more that 25 percent	**9 Max 3 per material**	**Not Met**		
F RF		**(2)**	engineered wood or engineered steel products				
F RF		**(3)**	roof or floor trusses				
F RF			NOTE: In the assigned Notes area, describe the types of products that comply with 608.1.				
F RF	**609.1**		**609.1 Regional materials.** Regional materials are used for major and/or minor components of the building.	**10 Max**		# of major components:	
F RF		**(1)**	Major component	**2 per each component**		# of minor components:	
F RF		**(2)**	Minor component	**1 per each component**	**Not Met**		
F RF			**For a component to comply with this practice, a minimum of 75% of all products in that component category must be sourced regionally, e.g., stone veneer category – 75 percent or more of the stone veneer on a project must be sourced regionally.**				
F RF			NOTE: In the assigned Notes areas, list major and minor materials used that comply with 609.1.				
F R	**610.1.2**		**610.1.2 Life cycle assessment for a product or assembly.** An environmentally preferable product or assembly is selected for an application based upon the use of an LCA tool that incorporates data methods compliant with ISO 14044 or other recognized standards that compare the environmental impact of products or assemblies.	**10 Max**			
F R	**610.1.2.1**		**610.1.2.1 Product LCA.** A product with improved environmental impact measures compared to another product(s) intended for the same use is selected. The environmental impact measures used in the assessment are selected from the following:		**Not Met**	# of comparisons with 4 measures:	
F R		**(a)**	Primary energy use				
F R		**(b)**	Global warming potential				
F R		**(c)**	Acidification potential				
F R		**(d)**	Eutrophication potential	**per Table 610.1.2.1 10 Max**			
F R		**(e)**	Ozone depletion potential			# of comparisons with 5 measures:	
F R		**(f)**	Smog potential				
F R			**(Points are awarded for each product/system comparison where the selected product/system improved upon the environmental impact measures by an average of 15 percent.)**				
F R			NOTE: List products/systems compared & impact measures considered in the assigned Notes area.				
F R	**610.1.2.2**		**610.1.2.2 Building assembly LCA.** A building assembly with improved environmental impact measures compared to an alternative assembly of the same function is selected. The full life cycle, from resource extraction to demolition and disposal (including but not limited to on-site construction, maintenance and replacement, material and product embodied acquisition, and process and transportation energy), is assessed. The assessment includes all structural elements, insulation, and wall coverings of the assembly. The assessment does not include electrical and mechanical equipment and controls, plumbing products, fire detection and alarm systems, elevators, and conveying systems. The following types of building assemblies are eligible for points under this practice:		**Not Met**	exterior walls:	
F R		**(a)**	exterior walls				
F R		**(b)**	roof/ceiling			roof/ceiling:	
F R		**(c)**	interior walls or ceilings				
F R		**(d)**	intermediate floors	**per Table 610.1.2.2 10 Max**			
F R			The environmental impact measures used in the assessment are selected from the following:			int. walls or ceilings:	
F R		**(a)**	Primary energy use				
F R		**(b)**	Global warming potential				
F R		**(c)**	Acidification potential				
F R		**(d)**	Eutrophication potential				
F R		**(e)**	Ozone depletion potential			intermediate floors:	
F R		**(f)**	Smog potential				
F R			**(Points are awarded based on the number of types of building assemblies that improve upon environmental impact measures by an average of 15 percent.)**				
F R			NOTE: List assemblies compared & impact measures considered in the assigned Notes area.				

F	RF	**612.1**		**612.1 Manufacturer's environmental management system concepts.** Product manufacturer's operations and business practices include environmental management system concepts, and the production facility is registered to ISO 14001 or equivalent. The aggregate value of building products from registered ISO 14001 or equivalent production facilities is 1 percent or more of the estimated total building materials cost. **(1 point awarded per percent.)** NOTE: In the assigned Notes area, list products that comply with 610.1, manufacturers, and ISO registrars.	**10 Max**	**Not Met**		
F	RF	**612.2**		**612.2 Sustainable products.** One or more of the following products are used for at least 30% of the floor or wall area of the entire dwelling unit or the sleeping unit, as applicable. Products are certified by a third-party agency accredited to ISO 17065.	**9 Max**	**Not Met**		
F	RF		**(1)**	50% or more of carpet installed (by square feet) is certified to NSF 140 or equivalent.	**3**		☐	
F	RF		**(2)**	50% or more of resilient flooring installed (by square feet) is certified to NSF 332 or equivalent.	**3**		☐	
F	RF		**(3)**	50% or more of the insulation installed (by square feet) is certified to UL 2985 or equivalent.	**3**		☐	
F	RF		**(4)**	50% or more of interior wall coverings installed (by square feet) is certified to NSF 342 or equivalent.	**3**		☐	
F	RF		**(5)**	50% or more of the gypsum board installed (by square feet) is certified to UL 100 or equivalent.	**3**		☐	
F	RF		**(6)**	50% or more of the door leafs installed (by number of door leafs) is certified to UL 102 or equivalent.	**3**		☐	
F	RF		**(7)**	50% or more of the tile installed (by square feet) is certified to TCNA A138.1 Specifications for Sustainable Ceramic Tiles, Glass Tiles and Tile Installation Materials or equivalent.	**3**		☐	
F	RF	**603.2**		**603.2 Salvaged materials.** Reclaimed and/or salvaged materials and components are used. The total material value and labor cost of salvaged materials is equal to or exceeds 1 percent of the total construction cost. **(Points awarded per 1% of salvaged materials used based on the total construction cost.)** NOTE: Describe materials used in the assigned Notes area. Materials, elements, or components awarded points under Section 603.1 shall not be awarded points under Section 603.2.	**1** **9 Max**	**Not Met**		
F	F	**611.1**		**611.1 Product declarations.** A minimum of 10 different products installed in the building project, at the time of certificate of occupancy, comply with one of the following sub-sections. Declarations, reports, and assessments are submitted and contain documentation of the critical peer review by an independent third party, results from the review, the reviewer's name, company name, contact information, and date of the review.	**5**	**Not Met**		
F	F	**611.1.1**		**611.1.1 Industry-wide declaration.** A Type III industry-wide environmental product declaration (EPD) is submitted for each product. Where the program operator explicitly recognizes the EPD as representative of the product group on a National level, it is considered industry-wide. In the case where an industry-wide EPD represents only a subset of an industry group, as opposed to being industry-wide, the manufacturer is required be explicitly recognized as a participant by the EPD program operator. All EPDs are required to be consistent with ISO Standards 14025 and 21930 with at least a cradle-to-gate scope. **(Each product complying with Section 611.1.1 shall be counted as one product for compliance with Section 611.1.)** NOTE: List products in the assigned Notes area.			# of products:	
F	F	**611.1.2**		**611.1.2 Product Specific Declaration.** A product specific Type III EPD are submitted for each product. The product specific declaration shall be manufacturer specific for an individual product or product family. All Type III EPDs are required to be certified as complying, at a minimum, with the goal and scope for the cradle-to-gate requirements in accordance with ISO Standards 14025 and 21930. **(Each product complying with Section 611.1.2 shall be counted as two products for compliance with Section 611.1.)** NOTE: List products in the assigned Notes area.			# of products (not effective number):	
F	RF	**604.1**		**604.1 Recycled content.** Building materials with recycled content are used for two minor and/or two major components of the building. Enter material percent recycled content. See Table 604.1 NOTE: In the assigned Notes area, list materials used for minor and/or major building components.	**per Table 604.1**	**Not Met**	First Minor Comp.: Second Minor Comp.: First Major Comp.: Second Major Comp.:	
F	RF	**13.104.4**		**13.104.4 Recycling and composting.** A readily accessible space(s) adequate to accommodate the recycling and composting containers for materials accepted in local recycling/composting programs is provided and identified on the floorplan.	**N/A**		☐	
CS	RF	**13.105**		**13.105 Energy Efficiency.**				
CS	R	**13.105.1**		**13.105.1 Building thermal envelope insulation.** The non-residential portion of the building must comply with the insulation requirements of Sections C402.1 through C402.3 of the ICC IECC as applicable, and Section 105.1.1. A UA tradeoff shall be allowed for sections 105.1 and 105.2 is equal to or less than the IECC UA. **Maximum UA.** For IECC residential, the total building UA is less than or equal to the total maximum UA as computed by 2015 IECC Section R02.1.5. For IECC commercial, the total UA is less than or equal to the sum of the UA for 2015 IECC Tables C402.1.4 and C402.4, including the U-factor times the area and C-factor or F-factor times the perimeter. The total UA proposed and baseline calculations are documented. REScheck or COMcheck is deemed to provide UA calculation documentation.	**Mandatory**		☐	
CS	R	**13.105.1.1**		**13.105.1.1 Insulation installation.** Insulation installed in the thermal envelope shall be visually inspected for compliance with Grade I installation. Grade II insulation is only permitted where exterior continuous insulation is installed. Grade III insulation installation is not permitted.	**Mandatory**		☐	
CS	R	**13.105.2**		**13.105.2 Building thermal envelope fenestration.** The non-residential portion of the building shall be in accordance with the requirements of Section C402.4 of the International Energy Conservation Code as applicable. Section C402.4 of the IECC	**Mandatory**		☐	
CS	R	**13.105.3**		**13.105.3 Building thermal envelope air sealing.** The building thermal envelope is durably sealed to limit infiltration. The sealing methods between dissimilar materials allow for differential expansion and contraction. The following are caulked, gasketed, weather-stripped or otherwise sealed with an air barrier material, suitable film, or solid material:				
CS	R		**(1)**	All joints, seams and penetrations	**Mandatory**			
CS	R		**(2)**	Site-built windows, doors and skylights	**Mandatory**			
CS	R		**(3)**	Openings between window and door assemblies and their respective jambs and framing	**Mandatory**			
CS	R		**(4)**	Utility penetrations	**Mandatory**			
CS	R		**(5)**	Dropped ceilings or chases adjacent to the thermal envelope	**Mandatory**			
CS	R		**(6)**	Knee walls	**Mandatory**			
CS	R		**(7)**	Walls and ceilings separating the garage from conditioned spaces	**Mandatory**			
CS	R		**(8)**	Behind tubs and showers on exterior walls	**Mandatory**			
CS	R		**(9)**	Cantilevers	**Mandatory**			
CS	R		**(10)**	Attic access openings	**Mandatory**			
CS	R		**(11)**	Rim joists junction	**Mandatory**			
CS	R		**(12)**	Other sources of infiltration	**Mandatory**			
CS	R	**13.105.3.1**		**13.105.3.1 Air barrier verification.** If not previously verified, the air barrier shall be visually inspected to demonstrate compliance with Table 701.4.3.2(2) and shall comply with the requirements of IECC C402.5.	**Mandatory**		☐	
F	RF	**13.105.4**		**13.105.4 Energy metering.** Energy metering shall be provided for each tenant individually for the non-residential portions of the building. **Exception:** non-residential spaces under 10,000 square feet.	**N/A**		☐	

CS	RF	13.105.5		**13.105.5 Efficiency of HVAC equipment.** HVAC equipment shall meet the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) of the International Energy Conservation Code.	N/A	☐	
CS	RF			NOTE: For Core & Shell projects, practice is recommended but not required.			
CS	RF	13.105.6		**13.105.6 Efficiency of Service Water Heating equipment.** Service Water Heating equipment shall meet the minimum efficiency requirements listed in ICC IECC Table C404.2.	N/A	☐	
CS	RF			NOTE: For Core & Shell projects, practice is recommended but not required.			
F	RF	13.105.7		**13.105.7 Lighting.** The total interior lighting power allowance shall be less than the total lighting power allowance in accordance with Section C405.3.2 of the International Energy Conservation Code.	N/A	☐	
F	RF	13.105.8		**13.105.8 Commissioning.**			
F	RF	13.105.8.1		**13.105.8.1 Mechanical and service water heating systems.** Mechanical and service water heating systems shall comply with ICC IECC Section C408.2.	N/A	☐	
F	RF			NOTE: C408.2 provides exemptions for: (1) systems where total mechanical equipment capacity is less than 480,000 Btu/h cooling capacity and 600,000 Btu/h combined service water heating and space-heating capacity; and (2) systems that serve individual dwelling and sleeping units.			
F	R	13.105.9		**13.105.9 Calculation of heating and cooling loads.** Design loads associated with heating, ventilating and air conditioning of the building shall be determined in accordance with ANSI/ASHRAE/ACCA Standard 183 or by an approved equivalent computational procedure and using the design parameters specified in Chapter 3 of the ICC IECC. Heating and cooling loads shall be adjusted to account for load reductions that are achieved where energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE HVAC Systems and Equipment Handbook or an approved equivalent computational procedure.	N/A	☐	
CS	R	13.105.10		**13.105.10 Duct air sealing.** Ductwork shall be constructed in accordance with the ICC IMC.	Mandatory		
CS	R			NOTE: For Core & Shell projects, practice is required if ducts are installed.			
F	RF	13.105.11		**13.105.11 Heated-water circulation and temperature maintenance.** Where installed, heated-water circulation systems shall be in accordance with Section 105.11.1. Heat trace temperature maintenance systems shall be in accordance with Section 105.11.2. Controls for hot water storage shall be in accordance with Section 105.11.3. Automatic controls, temperature sensors, and pumps shall be in a location that is accessible. Manual controls shall be in a location with ready access.	N/A		
F	RF	13.105.11.1		**13.105.11.1 Circulation systems.** Heated-water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe, or a cold water supply pipe. Gravity and thermos-syphon circulation systems shall be prohibited. Controls for circulation hot water system pumps shall start the pump based on the identification of a demand for hot water. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is not a demand for hot water.	N/A		
F	RF	13.105.11.2		**13.105.11.2 Heat trace systems.** Electric heat trace systems shall comply with IECC 505.1. Controls for such systems shall be able to automatically adjust the energy input to the heat tracing to maintain the desired water temperature in the piping in accordance with the times when heated water is used in the occupancy. Heat trace shall be arranged to be turned off automatically when there is not a demand for hot water.	N/A		
F	RF	13.105.11.3		**13.105.11.3 Controls for hot water storage.** The controls on pumps that circulate water between a water heater and a heated water storage tank shall limit the operation of the pump from the heating cycle startup to not greater than 5 minutes at the end of the cycle.	N/A		
F	RF	13.105.12		**13.105.12 Energy options.** Non-residential portions of the building shall comply with one of the three options below:	N/A		
F	RF	13.105.12.1		**13.105.12.1.** Energy requirements shall be met if modeling in accordance with C407 shows a 10% reduction in energy from the IECC.			
F	RF	13.105.12.2		**13.105.12.2.** Energy requirements shall be met if modeling in accordance with ASHRAE 90.1 Appendix G shows a 10% reduction in energy cost from the prescribed levels.			
F	RF	13.105.12.3		**13.105.12.3.** Energy requirements shall be met if at least two options in IECC Section C406 are met.			
F	RF			NOTE: List which options from C406 that were met in the assigned Notes field.			
F	RF	13.106		**13.106 Water efficiency and conservation.**			
F	RF	13.106.1		**13.106.1 Fitting and fixture consumption.** Plumbing fixtures and fixture fittings shall comply with the maximum flow rates specified in Table 106.1. Plumbing fixtures and fixture fittings in Table 106.1 shall have a manufacturer's designation for flow rate.	N/A	☐	
				Exceptions: The following fixtures and devices shall not be required to comply with the reduced flow rates in Table 106.1.			
F	RF		**(1)**	Clinical sinks having a maximum water consumption of 4.5 gallons (17 L) per flush.			
F	RF		**(2)**	Service sinks faucets, tub fillers, pot fillers, laboratory faucets, utility faucets, and other fittings designed primarily for filling operations.			
F	RF		**(3)**	Fixtures, fittings, and devices whose primary purpose is safety.			
F	RF	13.106.2		**13.106.2 Once-through cooling for appliances and equipment.** Once-through or single-pass cooling with potable or municipal reclaimed water is prohibited.	N/A	☐	
F	F	13.106.3		**13.106.3 Clothes washers.** Clothes washers rated with an IWF (integrated water factor), MEF (modified energy factor), or IMEF (integrated modified energy factor), shall be rated as follows:			
F	F		**(1)**	Residential Clothes Washers, Front-loading, > 2.5 cu-ft maximum IWF 3.2 minimum IMEF 2.76	N/A		
F	F		**(2)**	Residential Clothes Washers, T op-loading, > 2.5 cu-ft maximum 4.3 IWF, minimum IMEF 2.06	N/A		
F	F		**(3)**	Residential Clothes Washers (≤ 2.5 cu-ft) maximum 4.2 IWF, minimum IMEF 2.07	N/A		
F	F		**(4)**	Commercial Clothes Washers maximum 4.0 IWF, minimum MEF 2.20	N/A		
F	F	13.106.4		**13.106.4 Food Service.**			
F	F	13.106.4.1		**13.106.4.1 Dipper wells.** The water supply to a dipper well shall have a shutoff valve and flow control valve. The maximum flow shall not exceed 1 gpm (3.78 lpm) at a supply pressure of 60 psi (413.7 kPa). The dipper well shall have a manufacturer's designation of flow rate.	N/A		
F	F	13.106.4.2		**13.106.4.2 Food waste disposal.** The disposal of food wastes that are collected as part of preparing ware for one or more of the following shall accomplish washing:	N/A		
F	F		**(1)**	A food strainer (scrapper) basket that is emptied into a trash can.			
F	F		**(2)**	A garbage grinder where the water flow into the food waste disposer is controlled by a load sensing device such that the water flow does not exceed 1 gpm under no-load operating conditions and 8 gpm under full-load operating conditions.			
F	F		**(3)**	A pulper or mechanical strainer that uses not more than 2 gpm of potable water.			
F	F	13.106.4.3		**13.106.4.3 Pre-rinse spray heads.** Food service pre-rinse spray heads shall have a manufacturers designation of flow rate, shall comply with the maximum flow rate in Table 1305.1, and shall shut off *automatically* when released.	N/A		
F	F	13.106.4.4		**13.106.4.4 Hand washing faucets.** Faucets for hand washing sinks in food service preparation and serving areas shall be of the self-closing type.	N/A		
F	RF	13.106.5		**13.106.5. Water softeners.** Water softeners shall comply with Sections 13.106.5.1 through 13.106.5.3.			
F	F	13.106.5.1		**13.106.5.1 Demand initiated regeneration.** Water softeners shall be equipped with demand-initiated regeneration control systems. Such control systems shall automatically initiate the regeneration cycle after determining the depletion, or impending depletion of softening capacity.	N/A		
F	F	13.106.5.2		**13.106.5.2 Water consumption.** Water softeners shall have a maximum water consumption during regeneration of 5 gal (18.9 L) per 1000 grains of hardness removed as measured in accordance with NSF 44.	N/A		
F	RF	13.106.5.3		**13.106.5.3 Waste connections.** Waste water from water softener regeneration shall not discharge to reclaimed, gray water or rainwater water collection systems and shall discharge in accordance with the *International Plumbing Code* .	N/A		
F	RF	13.106.6		**13.106.6 Heat exchangers.** Once-through or single-pass cooling with potable or municipal reclaimed water is prohibited. Heat exchangers shall be connected to a recirculating water system such as a chilled water loop, cooling tower loop, or similar recirculating system.	N/A		

F	F	**13.107**		**13.107 Indoor Air Quality.**				
F	F	**13.107.1**		**13.107.1 Carpets.** Carpeting is not installed adjacent to water closets and bathing and or shower fixtures.	N/A		☐	
F	F	**13.107.1.1**		**13.107.1.1 Entry.** The primary entryway from the outdoors shall include one of the following:	N/A		☐	
F	F		**(1)**	Permanent walk-off mat that allows access for cleaning (e.g., grating with catch basin); or				
F	F		**(2)**	Roll-out mat that will be maintained on a weekly basis by a contracted service.				
CS	R	**13.107.2**		**13.107.2 Prohibited materials.** The use of the following materials shall be prohibited:				
CS	R		**(1)**	Asbestos-containing materials	Mandatory		☐	
CS	R		**(2)**	Urea-formaldehyde foam insulation	Mandatory		☐	
F	RF	**13.107.3**		**13.107.3 Product emissions.** At least five types of the following product categories must meet their respective section of the Standard referenced below:	N/A	0 met		
F	RF	**901.4**		**901.4** Wood materials. A minimum of 85 percent of material within a product group (i.e., wood structural panels, countertops, composite trim/doors, custom woodwork, and/or component closet shelving) is manufactured in accordance with the following:	10 Max	Not Met		
F	R		**(1)**	Structural plywood used for floor, wall, and/or roof sheathing is compliant with DOC PS 1 and/or DOC PS 2. OSB used for floor, wall, and/or roof sheathing is compliant with DOC PS 2. The panels are made with moisture-resistant adhesives. The trademark indicates these adhesives as follows: Exposure 1 or Exterior for plywood, and Exposure 1 for OSB.				
F	R			NOTE: If "N/A" is selected, please explain in the Notes area.				
F	RF			Countertops				
F	RF			Composite trim/doors				
F	RF			Custom woodwork				
F	RF			Component closet shelving				
F	RF		**(2)**	Particleboard and MDF (medium density fiberboard) is manufactured and labeled in accordance with CPA A208.1 and CPA A208.2, respectively.	2			
F	RF		**(3)**	Hardwood plywood in accordance with HPVA HP-1.	2			
F	RF		**(4)**	Particleboard, MDF, or hardwood plywood is in accordance with CPA 4.	3			
F	RF		**(5)**	Composite wood or agrifiber panel products contain no added urea-formaldehyde or are in accordance with the CARB *Composite Wood Air Toxic Contaminant Measure Standard* .	4			
F	RF		**(6)**	Non-emitting products.	4			
F	F	**901.5**		**901.5 Cabinets.** A minimum of 85 percent of installed cabinets are in accordance with one or both of the following:		Not Met		
F	F			**(Where both of the following practices are used, only 3 points are awarded.)**				
F	F		**(1)**	All parts of the cabinet are made of solid wood or non-formaldehyde emitting materials such as metal or glass.	5	0	☐	
F	F		**(2)**	The composite wood used in wood cabinets is in accordance with CARB *Composite Wood Air Toxic Contaminant Measure Standard* or equivalent as certified by a third-party program such as, but not limited to, those in Appendix B.	3	0	☐	
F	F	**901.7**		**901.7 Floor materials.** The following types of finished flooring materials are used. The materials have emission levels in accordance with CDPH/EHLB Standard Method v1.1. Product is tested by a laboratory with the CDPH/EHLB Standard Method v1.1 within the laboratory scope of accreditation to ISO/IEC 17025 and certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	1 8 Max	Not Met		
F	F			**(Points are awarded for every 10% of conditioned floor space using one of the below materials.)**			actual %:	
F	F		**(1)**	Hard surface flooring: Prefinished installed hard-surface flooring is installed. Where post-manufacture coatings or surface applications have not been applied, the following hard surface flooring types are deemed to comply with the emission requirements of this practice:			☐	
F	F		**(a)**	Ceramic tile flooring				
F	F		**(b)**	Organic-free, mineral-based flooring				
F	F		**(c)**	Clay masonry flooring				
F	F		**(d)**	Concrete masonry flooring				
F	F		**(e)**	Concrete flooring				
F	F		**(f)**	Metal flooring			actual %'s:	
F	F		**(2)**	Carpet meeting and carpet cushion not meeting the emission limits is installed.			☐	
F	F		**(3)**	Carpet and carpet cushion meeting the emission limits is installed.			☐	
F	F			**(When carpet cushion meeting the emission limits of the practice is also installed, the percentage of compliant carpet area is calculated at 1.33 times the actual installed area.)**				
F	F	**901.8**		**901.8 Wall coverings.** A minimum of 10 percent of the interior wall surfaces are covered and a minimum of 85 percent of wall coverings are in accordance with the emission concentration limits of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	4	Not Met	☐	
F	F	**901.9**		**901.9 Interior architectural coatings.** A minimum of 85 percent of the interior architectural coatings are in accordance with either Section 901.9.1 or Section 901.9.3, not both. A minimum of 85 percent of architectural colorants are in accordance with Section 901.9.2.		Not Met		
F	F	**901.9.1**		**901.9.1** Site-applied interior architectural coatings, which are inside the water proofing envelope, are in accordance with one or more of the following:	5	0		
F	F		**(1)**	Zero VOC as determined by EPA Method 24 (VOC content is below the detection limit for the method)			☐	
F	F		**(2)**	GreenSeal GS-11			☐	
F	F		**(3)**	CARB *Suggested Control Measure for Architectural Coatings* (see Table 901.9.1).			☐	
F	F			See Table 901.9.1				
F	F	**901.9.2**		**901.9.2** Architectural coating colorant additive VOC content is in accordance with Table 901.9.2.	1	0	☐	
F	F			**(Points for 901.9.2 are awarded only if base architectural coating is in accordance with 901.9.1.)**				
F	F			See Table 901.9.2				
F	F	**901.9.3**		**901.9.3** Site-applied interior architectural coatings, which are inside the waterproofing envelope, are in accordance with the emission levels of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 in its scope of accreditation. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those found in Appendix B.	8	0	☐	
F	F	**901.10**		**901.10 Interior adhesives and sealants.** A minimum of 85 percent of site-applied adhesives and sealants located inside the waterproofing envelope are in accordance with one of the following, as applicable.		Not Met		
F	F		**(1)**	The emission levels are in accordance with CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation. The product is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those found in Appendix B.	8		☐	
F	F		**(2)**	GreenSeal GS-36.	5		☐	
F	F		**(3)**	SCAQMD Rule 1168 in accordance with Table 901.10(3), excluding products that are sold in 16 ounce containers or less and are regulated by the California Air Resources Board (CARB) Consumer Products Regulations.	5		☐	
F	F			See Table 901.10(3)				
F	RF	**901.11**		**901.11 Insulation.** Emissions of 85 percent of wall, ceiling, and floor insulation materials are in accordance with the emission levels of CDPH/EHLB Standard Method v1.1. Emission levels are determined by a laboratory accredited to ISO/IEC 17025 and the CDPH/EHLB Standard Method v1.1 is in its scope of accreditation. Insulation is certified by a third-party program accredited to ISO 17065, such as, but not limited to, those in Appendix B.	4	Not Met	☐	

F	RF	**13.107.4**		**13.107.4 Fireplaces and appliances.** Where located within buildings, fireplaces, solid fuel-burning appliances, vented decorative gas appliances, vented gas fireplace heaters and decorative gas appliances for installation in fireplaces shall comply with Sections 107.4.1 through 107.4.5.	N/A		
F	RF	**13.107.4.1**		**13.107.4.1 Venting and combustion air.** Fireplaces and fuel-burning appliances shall be vented to the outdoors and shall be provided with combustion air provided from the outdoors in accordance with the International Mechanical Code and the International Fuel Gas Code. Solid-fuel-burning fireplaces shall be provided with a means to tightly close off the chimney flue and combustion air openings when the fireplace is not in use.	N/A		
F	RF	**13.107.4.2**		**13.107.4.2 Wood-fired appliances.** Wood stoves and wood-burning fireplace inserts shall be listed and, additionally, shall be labeled in accordance with the applicable requirement.	N/A		
F	RF		**(1)**	Site-built masonry wood-burning fireplaces use outside combustion air and include a means of sealing the flue and the combustion air outlets to minimize interior air (heat) loss when not in operation.	N/A		
F	RF		**(2)**	Factory-built, wood-burning fireplaces are in accordance with the certification requirements of UL 127.	N/A		
F	RF		**(3)**	Wood stove and fireplace inserts, as defined in UL 1482 Section 3.8, are in accordance with the certification requirements of UL 1482.	N/A		
F	RF	**13.107.4.3**		**13.107.4.3 Biomass appliances.** Biomass fireplaces, stoves and inserts shall be listed and labeled in accordance with ASTM E 1509 or UL 1482. Biomass furnaces shall be listed and labeled in accordance with CSA B366.1 or UL 391. Biomass boilers shall be listed and labeled in accordance with CSA B366.1 or UL 2523.	N/A		
F	RF	**13.107.4.4**		**13.107.4.4 Gas-fireplaces.** Gas-fired fireplaces and direct heating equipment is listed and is installed in accordance with the NFPA 54, ICC IFGC, or the applicable local gas appliance installation code. Gas-fired fireplaces within dwelling units and direct heating equipment are vented to the outdoors.	N/A		
F	RF	**13.107.4.5**		**13.107.4.5 Unvented.** Unvented room heaters and unvented decorative appliances, including alcohol burning, shall be prohibited.	N/A	☐	
F	RF	**13.107.5**		**13.107.5 Protection of HVAC system openings.** HVAC supply and return duct and equipment openings shall be protected during dust-producing operations of construction.	N/A	☐	
CS	RF	**13.107.6**		**13.107.6 Garages.** Attached garages are in accordance with the following:			
CS	RF		**(1)**	Doors installed in the common wall between the attached garage and conditioned space are tightly sealed and gasketed.	Mandatory		
CS	RF		**(2)**	A continuous air barrier is provided separating the garage space from the conditioned spaces.	Mandatory		
F	RF	**13.107.7**		**13.107.7 Spot Ventilation.** Exhaust systems shall be provided in accordance with Chapter 5 of the ICC IMC or ASHRAE 62.1.	N/A	☐	
F	RF	**13.107.8**		**13.107.8 Building Ventilation Systems.**			
F	RF	**13.107.8.1**		**13.107.8.1 Building Ventilation.** Ventilation shall be provided to non-residential spaces in accordance with Chapter 4 of the ICC IMC or ASHRAE 62.1.	N/A	☐	
F	RF	**13.107.8.2**		**13.107.8.2 Air filters.** Air filters with a minimum MERV rating of 6 are installed on central forced air systems and are accessible.	N/A	☐	

CS	RF	**13.107.9**			**13.107.9 Radon system.** Commercial spaces in building located in Zone 1 shall comply with section 902.3.			
CS	RF	**902.3**			**902.3 Radon reduction measures.** Radon reduction measures are in accordance with ICC IRC Appendix F or 902.3.1. Radon Zones as identified by the AHJ or, if the zone is not identified by the AHJ, as defined in Figure 9(1).	N/A		
CS	R		**(1)**		Buildings located in Zone 1			
CS	R			**(a)**	a passive radon system is installed	N/A		
CS	R			**(b)**	an active radon system is installed			
CS	R	**902.3.1**			**902.3.1 Radon reduction option.** This option requires section 902.3.1.1 through 902.3.1.7.			
CS	R	**902.3.1.1**			**902.3.1.1 Soil-gas barriers and base course.** A base course in accordance with Section 506.2.2 of the IRC shall be installed below slabs and foundations. There shall be a continuous gas-permeable base course under each soil-gas retarder that is separated by foundation walls or footings. Between slabs and the base course, damp proofing or water proofing shall be installed in accordance with Section 406 of the IRC. Punctures, tears and gaps around penetrations of the soil-gas retarder shall be repaired or covered with an additional soil-gas retarder. The soil-gas retarder shall be a continuous6-mil (0.15 mm) polyethylene or an approved equivalent.			
CS	R	**902.3.1.2**			**902.3.1.2 Soil gas collection.** There shall be an unobstructed path for soil gas flow between the void space installed in the base course and the vent through the roof. Soil gases below the foundation shall be collected by a perforated pipe with a diameter of not less than 4 inches (10 cm) and not less than 5 feet (1.5 m) in total length. A tee fitting or equivalent method shall provide two horizontal openings to the radon collection. The tee fitting shall be designed to prevent clogging of the radon collection path. Alternately the soil gas collection shall be by approved radon collection mats or an equivalent approved method.			
CS	R	**902.3.1.3**			**902.3.1.3 Soil gas entry routes.** Openings in slabs, soil-gas retarders, and joints such as, but not limited to, plumbing, ground water control systems, soil-gas vent pipes, piping and structural supports, shall be sealed against air leakage at the penetrations. The sealant shall be a polyurethane caulk, expanding foam or other approved method. Foundation walls shall comply with Section 103.2.3 of the IRC. Sumps shall be sealed in accordance with Section 103.2.2 of the IRC. Sump pits and sump lids intended for ground water control shall not be connected to the sub-slab soil-gas exhaust system.			
CS	R	**902.3.1.4**			**902.3.1.4 Soil gas vent.** A gas-tight pipe vent shall extend from the soil gas permeable layer though the roof. The vent pipe size shall not be reduced at any location as it goes from gas collection to the roof. Exposed and visible interior vent pipes shall be identified with not less than one label reading "Radon Reduction System" on each floor and in habitable attics.			
CS	R	**902.3.1.5**			**902.3.1.5 Vent pipe diameter.** The minimum vent pipe diameter shall be as specified in Table 902.3.2.5.			
CS	R	**902.3.1.6**			**902.3.1.6 Multiple vented areas.** In dwellings where interior footings or other barriers separate the soil-gas permeable layer, each area shall be fitted with an individual vent pipe. Vent pipes shall connect to a single vent that terminates above the roof or each individual vent pipe shall terminate separately above the roof.			
CS	R	**902.3.1.7**			**902.3.1.7 Fan.** Each sub-slab soil-gas exhaust system shall include a fan, or dedicated space for the post-construction installation of a fan. The electrical supply for the fan shall be located within 6 feet (1.8 m) of the fan. Fan is not required to be on a dedicated circuit.			
CS	RF	**902.3.2**			**902.3.2 Radon testing.** Radon testing is mandatory for Zone 1.	N/A		
CS	RF				**Exceptions:**		Exception:	
CS	RF				(2) Testing is not mandatory where the occupied space is located above an unenclosed open space.		☐	
CS	RF							
CS	F		**(1)**		Testing specifications. Testing is performance as specified in (a) through (j).		☐	
CS	F			**(a)**	Testing is performed after the residence passes its airtightness test.		Test results (pCi/L):	
CS	F			**(b)**	Testing is performed after the radon control system installation is complete. If the system has an active fan, the residence shall be tested with the fan operating.			
CS	F			**(c)**	Testing is performed at the lowest level within a dwelling unit which will be occupied, even if the space is not finished.			
CS	F			**(d)**	Testing is not performed in a closet, hallway, stairway, laundry room, furnace room, kitchen or bathroom.			
CS	F			**(e)**	Testing is performed with a commercially available test kit or with a continuous radon monitor that can be calibrated. Testing shall be in accordance with the testing device manufacturer's instructions.			
CS	F			**(f)**	Testing shall be performed by the builder, a registered design professional, or an approved third party.			
CS	F			**(g)**	Testing shall extend at least 48 hours or to the minimum specified by the manufacturer, which ever is longer.			
CS	F			**(h)**	Written radon test results shall be provided by the test lab or testing party. Written test results shall be included with construction documents.			
CS	F			**(i)**	An additional pre-paid test kit shall be provided for the homeowner to use when they choose. The test kit shall include mailing or emailing the results from the testing lab to the homeowner.			
CS	F			**(j)**	Where the radon test result is 4 pCi/L or greater, the fan for the radon vent pipe shall be installed.			
F	RF	**13.108**			**13.108 Operation, Maintenance, and Building Owner Education.**			
F	RF	**13.108.1**			**13.108.1 OPERATION AND MAINTENANCE MANUALS FOR TENANTS.** Manuals are provided to the initial tenants of the non-residential space regarding the operation, and maintenance of the building. Paper or digital format manuals are to include information regarding those aspects of the building's maintenance, and operation that are within the area of responsibilities of the respective tenant. One or more responsible parties are to receive a copy of all documentation for archival purposes.	N/A	☐	
F	RF		**(1)**		A narrative detailing the importance of operating in a green building. This narrative is included in all responsible parties' manuals.			
F	RF		**(2)**		A list of practices to conserve water and energy which require maintenance.			
F	RF		**(3)**		Information on opportunities to purchase renewable energy from local utilities or national green power providers.			
F	RF		**(4)**		Information on local and on-site recycling and hazardous waste disposal programs.			
F	RF		**(5)**		Local public transportation options for employees.			
F	RF	**13.108.2**			**13.108.2 TENANT FINISH-OUT MANUAL.** Manuals are provided to the tenants of the non-residential space prior to the start of construction regarding the design and construction of the non-residential portion of the building. Paper or digital format manuals are to include information regarding those aspects of the design and construction that are within the area of responsibilities of the respective tenant. One or more responsible parties are to receive a copy of all documentation for archival purposes.	N/A	☐	
F	RF		**(1)**		Provisions of this Chapter verified at the time of building Certification for the respective space that shall be maintained as part of the Tenant Finish Out			
F	RF		**(2)**		Provisions of this Chapter NOT verified at the time of building Certification for the respective space that shall be included in the Tenant Finish Out Construction Documents.			
F	RF		**(3)**		A list of minimum green building material specifications that are to be included in the Tenant Finish Out Construction Documents based on the materials that were installed in the residential portion of the building.			

Net Zero Energy: See Section Header
Resilience: Not Earned
Smart Home: Not Earned
Universal Design: Not Earned
Wellness: Not Earned
Zero Water: Not Earned

NGBS GREEN
Home Innovation Research Labs

Version 1.2 / Revised September 2021

Mandatory Information is missing on the Overview (Verification) page!

Home Address:

Community/Lot #:

Net Zero Energy

Not expected to meet based on Performance Path inputs, but compliance possible based on energy analysis document

		Verifier Notes	Design Phase Notes
Building Envelope			
Roof R-Value:			None
Floor R-Value:			None
Wall R-Value:			None
Describe Wall Section:			None
Window-Wall Ratio:			None
Window U-Value:			None
Window SHGC:			None
Window Description:			None
Exterior Shading Devices:			None
Air Leakage Test Results:			None
Air Sealing Protocol Description:			None
Lighting			
Type of Lighting Description:			None
Daylighting Features Description:			None
Occupancy Sensors Description:			None
Describe Lighting Design & Control Strategy:			None
HVAC System Characteristics (Check all included technologies and note efficiency values)			
Gas and Propane Heater	☐		None
Oil Furnace	☐		None
Gas Boiler	☐		None
Oil Boiler	☐		None
Radiant and Hydronic Space Heating	☐		None
Electric Heat Pump	☐		None
Gas Engine-Driven Heat Pump Heating	☐		None
Electric Air Conditioner and Heat Pump Cooling	☐		None
Gas Engine-Driven Heat Pump Cooling	☐		None
Water Source Cooling and Heating	☐		None
Ground Source Heat Pump	☐		None
Describe Mechanical System:			None
Ventilation			
Spot Ventilation Only:	☐		None
Building Ventilation Systems:	☐		None
Energy Storage			
Battery Storage Description:			None
Renewable Energy System Characteristics			
Describe systems here. Submit photos of installed on-site systems and appropriate documentation (e.g., solar installer design report, power purchase agreement, or renewable energy credit certificate) of installed system.			
Projected energy usage:			None
Projected renewable energy delivered:			None
Solar electric (PV): array size and output per capacity nameplate, panel quantity, type and brand, inverter quantity, type and location(s).			None
Solar Thermal			
Collector Area (ft^2):			None
Collector Slope(degrees):			
Efficiency(%):			
Tank Volume (gallons):			
Maximum Heating Rate (Btu/hr):			
Wind: (If onsite: note turbine size and output in peak kw, inverter type, brand and location. If off-site, note farm location, overall size, and purchased share of energy expected.)			None
Have Renewable Energy Credits been retained? If yes, describe amount (KWh) and plan for recurring purchase, if any.			None
Geothermal			
Maximum Power (hp):			None
Surface Temperature of Fluid (F):			
Estimated Reservoir Temperature at 6,500 Feet (F):			
Area of Geothermal Field (mi^2):			
Number of Wells Drilled:			
Efficiency (%):			

Resilience

Not Earned

SECTION 1: ENHANCED RESILIENCE

Requirements:

Meet one of the below practices.

Practices

		Verifier Notes	Design Phase Notes
613.5 Enhanced resilience - 30% above base design 613.6 Enhanced resilience - 40% above base design 613.7 Enhanced resilience - 50% above base design	**Not Met**		None

SECTION 2: RENEWABLE ENERGY AND BATTERY ENERGY STORAGE SYSTEMS

Requirements:

Meet mandatory practice.

Practices

		Verifier Notes	Design Phase Notes
706.5(3) On-site renewable energy system and battery energy storage system	**Not Met**		None

Additional Requirements

Identify resilient construction features and benefits are described in homeowner or multifamily occupant manual.

☐		None

Smart Home

Not Earned

SECTION 1: LIGHTING & LIGHTING CONTROLS /WINDOW SHADING

Requirements:

Meet applicable mandatory practice.

Select optional practices to contribute toward meeting overall point total (18 required).

Practices	Points Available			
612.3(9) Automated or voice-activated control of HVAC, lighting, alarm system or door locks	Mandatory	**Not Met**		None
703.7.2 Automated Solar Protection	1	☐		
705.2.1.1(1 or 2) Interior Lighting Controls	1-2	**0**		
705.2.1.2 Exterior Lighting Controls	1	**0**		
705.2.3 Lighting Outlets	1	**0**		
705.2.1.3(1-2) Multifamily Common Areas	1-5 (MF Only)	**0**		
705.2.1.4(1-2) Multifamily Occupancy Controls	2-3 (MF Only)	**0**		

SECTION 2: ENERGY & WATER CONSUMPTION CONTROL

Requirements

Meet applicable mandatory practice.

Select optional practices to contribute toward meeting overall point total (18 required).

Practices	Points Available			
706.1(1) Remote, Programmable Thermostat	Mandatory	**Not Met**		None
706.10 Automatic Demand Response	1	**0**		
706.11 Grid-Interactive Battery Storage	2	**0**		
1004.1(2) Verification System for Post-Occupancy Monitoring	3	**0**		
706.1(2-5) Energy Consumption Control	2	**0**		
706.3 Smart Appliances and Systems	1-2	**0**		

SECTION 3: SMART CONTROLS FOR WATER EFFICIENCY

Requirements:

Meet applicable mandatory practice.

Select optional practices to contribute toward meeting overall point total (18 required).

Practices	Points Available			
802.6.4(1) Smart Irrigation Controller	Mandatory	☐		None
802.6.5(5) Irrigation Flow Sensing Device	3	☐		
802.10.1(1) Automated Motorized Non-Permeable Pool Cover	10 (SF Only)	☐		
803.3(1-2) Automatic Leak Detection and Control Device	2			

SECTION 4: VENTILATION & HUMIDITY CONTROL

Requirements:

Select optional practices to contribute toward meeting overall point total (18 required).

Practices	Points Available			
706.12 Smart Ventilation	1	**0**		None
905.1 Humidity Monitoring System	2	**0**		

Additional Requirements

Identify smart home features and potential for conserving energy or water in homeowner or multifamily occupant manual.		☐		None

Total Points:
0

need 18 more

Universal Design

Not Earned

UNIVERSAL DESIGN

Requirements:

Meet mandatory practices.

Practices	
612.3(1) No-step entrance	**Not Met**
612.3(2) Accessible route from entrance to visiting room and bathroom	**Not Met**
612.3(3) Accessible route from entrance to bedroom	**Not Met**
612.3(4) Blocking or equivalent installed for future installation of grab bars	**Not Met**
612.3(5) Door handles are levers	**Not Met**
612.3(6) Sink, lavatory, and exterior door handles comply with ICC A117.1	**Not Met**
612.3(7) Power receptacles placed 15-48" above finished floor	**Not Met**
612.3(8) Light switches are rocker-style switches	**Not Met**
612.3(9) Wireless or voice-activated control of HVAC, lighting, alarm systems, window treatments, or door locks	**Not Met**

Wellness

Not Earned

SECTION 1: AIR

Requirements:

Meet all applicable mandatory practices.

Meet at least 3 optional practices. These practices contribute toward meeting the overall point total (29 required).

Practices	Points Available			
901.1.1 Natural draft furnaces and boilers not located in conditioned space	Mandatory			None
901.1.5 Vented Natural Gas and Propane Fireplaces	Mandatory			
902.2.1 Building Ventilation Systems	Mandatory	**Not Met**		
901.15(1-2) Non-Smoking Areas	Mandatory (MF)	**Not Met**		
901.1.2 Air handling equipment not installed in garage	Mandatory	**Met**		
902.1.6 Ventilation for Multifamily Common Spaces	3 (MF Only)	**0**		
901.2.2 No Fireplaces, Woodstoves, Pellet Stoves, or Masonry Heaters are Installed	6	**0**		
902.4 HVAC System Protection	3	**0**		
904.1 IAQ During Construction	2	**0**		
904.2 IAQ Post-Construction	3	**0**		
706.12 Smart Ventilation	1	**0**		
902.2.4 MERV Filters 14 or Greater	3	**0**		

SECTION 2: MOVEMENT

Requirements:

Select at least one item from Group A.

Select optional practices from Group B to contribute toward meeting overall point total (29 required).

Practices				
GROUP A				None
501.2(3) Pedestrian Activity				
501.2(4) Walkability		**Not Met**		
505.10(a) Indoor area for adult exercise and/or children's play equipment (MF Only)				
505.10(b) Courtyard, garden, terrace, or roof space for play/recreation (MF Only)				
Exception : single-family homes unable to comply with 501.2(3) or 501.2(4) due to the low surrounding developmental density can meet this requirement if they demonstrate that they are within walking distance (0.5 mile) from a community facility that meet the intent of 505.10(a) or 505.10(b), such as a public park or sports facility.				
GROUP B	Points Available			
501.2(5) Bicycle Use	5	**0**		
501.2(6) Bicycle Parking	2-8 (MF Only)	**0**		
501.2(1) Pedestrian access to mass transit system	6	**0**		
501.2(8) Access to bike sharing program	5	**0**		
505.4 Mixed-use development	8 (MF Only)	**0**		

SECTION 3: MOISTURE MANAGEMENT

Requirements:

Meet mandatory practice.

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available			
602.1.7.1(1, 3) Moisture Control Measures	Mandatory	**Not Met**		None
602.1.12 Roof Overhangs	4 (SF Only)	**0**		
602.1.10 Exterior Doors	2-6	**0**		

SECTION 4: COMFORT

Requirements:

Meet mandatory practice.

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available			
903.3 Relative humidity	Mandatory			None
905.1 Humidity monitoring system	2	**0**		

SECTION 5: NOURISHMENT

Requirements:

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available			
505.5(a) Community garden	3-9 (MF Only)	**0**		None
505.5(b) Proximity to market/farm stand	3 (MF Only)	**0**		

SECTION 6: LIGHT

Requirements:

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available			
703.7.2 Window Shading	1	**0**		None
706.1(5) Lighting Control System	1	**0**		

SECTION 7: SOUND

Requirements:

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available			
905.4 Sound Barrier	1-3	**0**		None

SECTION 8: MATERIALS

Requirements:

Achieve a minimum of 15 points from the following practices. These practices contribute toward meeting the overall point total (29 required).

Practices	Points Available			
612.2 Sustainable Products	3-9	**0**		None
901.5 Low/no- formaldehyde cabinets	3-8	**0**		
901.7 Low-emission floor materials	1-8	**0**		
901.8 Low-emission wall coverings	4	**0**		
901.12 Low-VOC furniture and furnishings	2 (MF Only)	**0**		

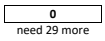
SECTION 9: ACCESS TO NATURE

Requirements:

Select optional practices to contribute toward meeting overall point total (29 required).

Practices	Points Available			
503.6(1) Wildlife gardens	3	**0**		None
503.6(2) Certified backyard wildlife	3	**0**		
503.6(3) Wildlife corridor or other preserved area	3	**0**		

Total Points:


0
need 29 more

Zero Water	Not Earned

WRI: **WRI not Entered**

Verifier Comments & Sign Off

I certify that the above requirements were met based on documentation review and on-site inspection. The features identified above were verified in accordance with the NGBS and guidance in the Verifier Agreement and Verifier's Resource Guide.
My company did not supply product, participate in the physical construction of this project, or operate otherwise that would compromise the independent of my verification services.

Verifier Signature:	
Verifier Comments:	
Name:	
Email:	
Phone:	
Start Time:	*(format: hh:mm AM)*
End Time:	
Date:	*(format: mm/dd/yyyy)*

WaterSense: Not Earned

Mandatory Information is missing on the Overview (Verification) page!

Home Address:

Community/Lot #:

WaterSense

Not Earned

		Verifier Notes	Design Phase Notes
Performance or Prescriptive Path?	Enter in Ver. Rep.		
LEAKS:			
Pressure-loss test on all water supplies detects no leaks.	☐		None
Free of visible leaks from hot water delivery system.	☐		None
Free of visible leaks from toilet(s), as determined through visual assessment and by conducting a dye tablet test in each toilet to ensure the flapper is not leaking.	☐		None
Free of visible leaks from bathroom faucets(s).	☐		None
Free of visible leaks from showerhead(s).	☐		None
Free of visible leaks from bathroom tub faucet(s), i.e., tub spout(s), when showerhead(s) is activated, as determined through visual assessment after showerhead has been activated for one minute.	☐		None
Free of visible leaks from kitchen and other sink faucet(s).	☐		None
Free of visible leaks from other fixtures or appliances (e.g., clothes washers, dishwashers, hose bibs, irrigation systems) at point of use of connection to water distribution system.	☐		None
TOILETS:			
Toilets are WaterSense labeled.	☐		None
802.5.4(3)	N/A		
LAVATORY FAUCETS:			
Lavatory faucets are WaterSense labeled.	☐		None
802.5.1(5)	N/A		
SHOWERHEADS:			
Showerheads are WaterSense labeled.	☐		None
802.4(1)	N/A		
IRRIGATION:			
No irrigation or landscaping planned:	☐		None
Where landscaping is planned, install native plants that are adapted for the local climate.			
503.5(2)	N/A		
Spray sprinkler systems: pressure-regulating valves and WaterSense labeled spray sprinkler bodies are installed.			
802.6.5(1)	N/A		

Notes:

- This item applies to spray sprinkler irrigation; this does not apply to areas with micro-irrigation or drip irrigation.
- Spray sprinkler body must be WaterSense labeled. An irrigation sprinkler nozzle tested in accordance with ASABE/ICC 802 Landscape Irrigation Sprinkler and Emitter Standard does not satisfy this item. NGBS practice 802.6.2 contributes toward but does not fully satisfy the intent of this practice.

Smart irrigation controllers are installed and WaterSense labeled.			
802.6.4(1)	N/A		

Notes:

- Confirm that the controllers are WaterSense labeled and featured on: https://www.epa.gov/watersense/irrigation-controllers
  It is insufficient to be in accordance with the performance criteria without certifying through EPA.

Irrigation system is designed, installed, and/or audited by an irrigation professional certified through a WaterSense labeled program.			
802.6.1	N/A		

Notes:

- Professional must be certified through a WaterSense labeled program and listed at: https://www.epa.gov/watersense/irrigation-pro
- *Exception* : if no certified irrigation professionals are accepting new work in the city, county, or metropolitan area where the building is located, this requirement can be satisfied with an audit conducted by a non-certified irrigation professional using the ASABE S636 Landscape Irrigation System Uniformity and Application Rate Testing Protocol to complete the irrigation audit. Use of this exemption must be documented and retained with the verifier's records.

WATER EFFICIENCY:			
Achieve a Water Rating Index score of 64 or lower.	N/A		
KITCHEN FAUCETS:			

All kitchen faucets have a maximum flow rate of 1.5 gpm.

802.5.2(2) | N/A

APPLIANCES:

When installed, clothes washer is ENERGY STAR or equivalent with an Integrated Water Factor of 3.8 or less. | None installed: ☐ | None

802.2(3) | N/A

When installed, dishwasher is ENERGY STAR or equivalent. | None installed: ☐ | None

802.2(1) (also qualifies for 703.6.2(2)) | N/A

HOT WATER DISTRIBUTION:

The maximum volume from the water heater to the termination of the fixture supply at furthest fixture is 64 ounces (0.5 gallon).

802.1(2) | N/A

ADDITIONAL PRACTICES FOR MULTIFAMILY:

Implement additional efficiency for toilets, showerheads, or hot water distribution systems. | N/A

OPTION A: All installed toilets have a maximum flush volume of 1.1 gpf. | ☐ | None

OPTION B: Showerheads have a maximum flow rate of 1.8 gpm.

802.4(2) | N/A

OPTION C: A central hot water recirculation system is implemented in multifamily buildings in which the hot water line distance from the recirculating loop to the engineered parallel piping system (i.e., manifold system) is less than 30 ft. (9,144 mm) and the parallel piping to the fixture fittings contains a maximum of 64 ounces (0.5 gallons).

802.1(5) | N/A

Verifier Comments & Sign Off

I certify that the above requirements were met based on documentation review and on-site inspection. The features identified above were verified in accordance with the NGBS and guidance in the Verifier Agreement and Verifier's Resource Guide.
My company did not supply product, participate in the physical construction of this project, or operate otherwise that would compromise the independent of my verification services.

Verifier Signature:	
Verifier Comments:	
Name:	
Email:	
Phone:	
Start Time:	*(format: hh:mm AM)*
End Time:	
Date:	*(format: mm/dd/yyyy)*

GRESB Checklist

The Global Real Estate Sustainability Benchmarking, or GRESB, is a framework that measures the ESG (Environmental, Social and Governance) performance of a company's real estate portfolio. Real estate developers and property managers will self-report their building performance and operations information to GRESB, where it is validated and benchmarked against the companies' peers. To learn more about GRESB, visit www.gresb.com.

Green building certifications like NGBS Green offer credible validation of ESG efforts and can contribute toward a higher GRESB score and/or ranking. By pursuing NGBS Green Certification, investors and property managers can fulfill many indicators within the "Development" section of GRESB. Visit www.HomeInnovation.com/ESG to learn more.

This NGBS-GRESB checklist identifies the GRESB indicators that are fulfilled by NGBS compliance. The checklist is for informational purposes; GRESB indicators that are "met" on this checklist are not guaranteed. When reporting to GRESB, proper and sufficient evidence is required to receive credit.

	DRE1 ESG strategy during development
☐	• Biodiversity and habitat
	• Building safety
	• Climate/climate change adaptation
☐	• Energy consumption
☐	• Green building certifications
	• Greenhouse gas emissions
☐	• Health and well-being
☐	• Indoor environmental quality
☐	• Life-cycle assessments/embodied carbon
☐	• Location and transportation
☐	• Material sourcing
☐	• Net-zero/carbon neutral design
☐	• Pollution prevention
☐	• Renewable energy
☐	• Resilience to catastrophe/disaster
☐	• Site selection and land use
☐	• Sustainable procurement
☐	• Waste management
☐	• Water consumption

	DRE2 Site selection requirements
☐	• Connect to multi-modal transit networks
☐	• Locate projects within existing developed areas
☐	• Protect, restore, and conserve aquatic ecosystems
☐	• Protect, restore, and conserve farmland
☐	• Protect, restore, and conserve floodplain functions
☐	• Protect, restore, and conserve habitats for native, threatened and endangered species
	• Protect, restore, and conserve historical and heritage sites
☐	• Redevelop brownfield sites

	DRE3 Site Design and Construction Requirements
☐	• Manage waste by diverting construction and demolition materials from disposal
☐	• Manage waste by diverting reusable vegetation, rocks, and soil from disposal
	• Minimize light pollution to the surrounding community

- [ ] • Minimize noise pollution to the surrounding community
- [ ] • Perform environmental site assessment
- [ ] • Protect air quality during construction
- [ ] • Protect and restore habitat and soils disturbed during construction and/or during previous development
- [ ] • Protect surface water and aquatic ecosystems by controlling and retaining construction pollutants

DMA1 Materials selection requirements

Requirement for disclosure about the environmental and/or health attributes of building materials

- [ ] • Environmental Product Declarations
- [ ] • Health Product Declarations

Material characteristics specification

- [ ] • Locally extracted or recovered materials
- [ ] • Low embodied carbon materials
- [ ] • Low-emitting VOC materials
- [ ] • Materials and packaging that can easily be recycled
- [ ] • Materials that disclose environmental impacts
- [ ] • Materials that disclose potential health hazards
- [ ] • Rapidly renewable materials and recycled content materials
- [ ] • "Red list" of prohibited materials or ingredients that should not be used on the basis of their human and/or
- [ ] • Third-party certified wood-based materials and products

DMA2.1 Life cycle assessments

- [ ] *Does the entity assess the life cycle emissions of its development projects?*

DEN1 Energy efficiency requirements

Requirements for planning and design include

- [ ] • Development and implementation of a commissioning plan
- [ ] • Integrative design process
- [ ] • To exceed relevant energy codes or standards
- [ ] • Requirements for minimum energy use intensity post-occupancy

Common energy efficiency measures

- [ ] • Air conditioning
- [ ] • Commissioning
- [ ] • Energy modeling
- [ ] • High-efficiency equipment and appliances
- [ ] • Lighting
- [ ] • Occupant controls
- [ ] • Passive Design
- [ ] • Space Heating
- [ ] • Ventilation
- [ ] • Water Heating

Operational energy efficiency monitoring

- [ ] • Building energy management systems
- [ ] • Energy use analytics
- [ ] • Post-construction energy monitoring
- [ ] • Sub-meter

DEN2.1 On-site renewable energy

- [ ] • Average design target for the fraction of total energy demand met with on-site renewable energy

DEN2.2 Net zero carbon design and standards

Does the entity's portfolio include any buildings designed to meet net zero carbon?

The entity's definition of "net zero carbon" includes:

☐ • Net zero carbon - construction
• Net zero carbon - operational energy
• Other: _____

The entity uses net zero carbon code/standard:

☐ • National/local green building council standard
• National/local government standard
• International standard
• Other: _____

DWT1 Water conservation strategy

Requirements for planning and design

• Development and implementation of a commissioning plan
☐ • Integrative design for water conservation
☐ • Requirements for indoor water efficiency
☐ • Requirements for outdoor water efficiency
☐ • Requirements for process water efficiency
☐ • Requirements for water supply
• Requirements for minimum water use intensity post-occupancy

Common water efficiency measures

☐ • Commissioning of water systems
☐ • Drip/smart irrigation
☐ • Drought tolerant/low-water landscaping
☐ • High-efficiency/dry fixtures
☐ • Leak detection system
☐ • Occupant sensors
☐ • On-site wastewater treatment
☐ • Reuse of stormwater and greywater for non-potable applications

Operational water efficiency monitoring

• Post-construction water monitoring
☐ • Sub-meter
• Water use analytics

DWS1 Waste management strategy

Management and construction practices

Construction waste signage
☐ Diversion rate requirements
☐ Education of employees/contractors on waste management
Incentives for contractors for recovering, reusing and recycling building materials
Targets for waste stream recovery, reuse and recycling
☐ Waste management plans
☐ Waste separation facilities

On-site waste monitoring

☐ Hazardous waste monitoring/audit
☐ Non-hazardous waste monitoring/audit

DSE1 Health and Well-being

Requirements for planning and design

- Health Impact Assessment
- Integrated planning process
- Other planning processes

Common occupant health and well-being measures

- ☐ Acoustic comfort
- ☐ Active design features
- ☐ Biophilic design
- ☐ Commissioning
- ☐ Daylight
- Ergonomic workplace
- ☐ Humidity
- ☐ Illumination
- ☐ Inclusive design
- ☐ Indoor air quality
- ☐ Natural ventilation
- ☐ Occupant controls
- ☐ Physical activity
- ☐ Thermal comfort
- ☐ Water quality

Provisions to verify health and well-being performance include

- ☐ Occupant education
- Post-construction health and well-being monitoring (e.g. occupant comfort and satisfaction)

DBC1.1 Green building standard requirements

Does the entity's development portfolio include projects that are aligned with green building rating standards?

require certification

- 2-The entity requires projects to achieve certification with a green building rating system but does not require a
- ☐ 3-The entity requires projects to achieve a specific level of certification

Summary After ROUGH Inspection

Scoring Tool Version: 5.2.20 Revision Date: 2/28/2024

Project ID: None entered on "Overview (Verification)" Sheet
Builder/Applicant: None entered on "Overview (Verification)" Sheet
Address of Home: None entered on "Overview (Verification)" Sheet
Community/Lot #: None entered on "Overview (Verification)" Sheet
Climate Zone: !! !! !! !!

Certification Level - As Designed: Silver
Building Type: Multifamily
Number of Units: 1
Conditioned Square Footage:
Project Description:

There are errors in the Verification Report Sheet!

There is missing mandatory information on this sheet!

Chapter	Designer	NO LONGER VALID Verifier	BRONZE	SILVER	GOLD	EMERALD
CHAPTER **5** LOT DESIGN	84	0	50	64	93	121
CHAPTER **6** RESOURCE EFFICIENCY	84	0	43	59	89	119
CHAPTER **7** ENERGY EFFICIENCY	67	0	30	45	60	70
CHAPTER **8** WATER EFFICIENCY	57	0	25	39	67	92
CHAPTER **9** INDOOR ENVIRONMENTAL QUALITY	56	0	25	42	69	97
CHAPTER **10** OPERATION, MAINTENANCE	18	2	8	10	11	12
Total	366	2	231	334	489	611

Builder Comments:

Name:
Email:
Phone:
Date:

Verifier Comments:

Name:
Email:
Phone:
Start Time: *(format: hh:mm AM)*
End Time:
Date: *(format: mm/dd/yyyy)*

Team Verification

(Completing this section is MANDATORY whenever multiple accredited verifiers are involved in the verification of a given building or homes within a batch.)

	Verifier Name	Role	Elements Verified *(if applicable)*	Inspection Dates *(if applicable)*
1				
2				
3				
4				
5				

OPTIONAL BATCH SUBMISSION

	Rough Address	City	State	Zip	Project ID	Inspection Date (format: mm/dd/yyyy)
1						
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6						
7						
8						
9						
10						
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50						

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- A batch can either consist of single-family homes or multifamily buildings; however, only NGBS Green Master Verifiers can batch multifamily.
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- Photos for each building are to be submitted, each titled with their respective Project ID.

SAMPLING – MULTIFAMILY AND SINGLE-FAMILY BUILD-TO-RENT.

Sampled Units – If sampling was performed, either complete table below or submit separate file (Excel or Word) with notes about which units were available and sampled.

	Date(s) of Visit	Number of Units Available for Inspection	Number of Units Inspected (Identify Initial Set and Sampled)	Notes
1				
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3				
4				
5				
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13				
14				
15				
16				
		TOTAL: 0	**TOTAL: 0**	

Summary After ROUGH Inspection For Commercial Spaces

Scoring Tool Version: 5.2.20 Revision Date: 2/28/2024

Project ID: None entered on "Overview (Verification)" Sheet
Builder/Applicant: None entered on "Overview (Verification)" Sheet
Address of Home: None entered on "Overview (Verification)" Sheet
Community/Lot #: None entered on "Overview (Verification)" Sheet
Climate Zone: !! !! !! !!

Comm. Space pathway selected: NOT PERSUING COMMERCIAL
Project Description:

There are errors in the Verification Report Sheet!

There is missing mandatory information on this sheet!

NGBS GREEN CERTIFIED • NGBS GREEN CERTIFIED • SAMPLE

NOT PURSUING COMMERCIAL

Client Comments:

Name:
Email:
Phone:
Date:

Verifier Comments:

Name:
Email:
Phone:
Start Time: *(format: hh:mm AM)*
End Time:
Date: *(format: mm/dd/yyyy)*

Team Verification

(Completing this section is MANDATORY whenever multiple accredited verifiers are involved in the verification of a given building or homes within a batch.)

	Verifier Name	Role	Elements Verified *(if applicable)*	Inspection Dates *(if applicable)*
1				
2				
3				
4				
5				

OPTIONAL BATCH SUBMISSION

	Rough Address	City	State	Zip	Project ID	Inspection Date (format: mm/dd/yyyy)
1						
2						
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Summary After FINAL Inspection

Scoring Tool Version: 5.2.20 Revision Date: 2/28/2024

Project ID: None entered on "Overview (Verification)" Sheet
Builder/Applicant: None entered on "Overview (Verification)" Sheet
Address of Home: None entered on "Overview (Verification)" Sheet
Community/Lot #: None entered on "Overview (Verification)" Sheet
Climate Zone: !! !! !! !!

Certification Level - Final: None
Building Type: Multifamily
Number of Units: 1
Conditioned Square Footage:
Project Description:

There are errors in the Verification Report Sheet!

There is missing mandatory information on this sheet!

Chapter	Designer	NOT YET FINAL PHASE Verifier	BRONZE	SILVER	GOLD	EMERALD
CHAPTER **5** LOT DESIGN	84	0	50	64	93	121
CHAPTER **6** RESOURCE EFFICIENCY	84	0	43	59	89	119
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Builder Comments:

Name:
Email:
Phone:
Date:

Verifier Comments:

Name:
Email:
Phone:
Start Time: *(format: hh:mm AM)*
End Time:
Date: *(format: mm/dd/yyyy)*

Team Verification

(Completing this section is MANDATORY whenever multiple accredited verifiers are involved in the verification of a given building or homes within a batch.)

	Verifier Name	Role	Elements Verified *(if applicable)*	Inspection Dates *(if applicable)*
1				
2				
3				
4				
5				

OPTIONAL BATCH SUBMISSION

	Final Address	City	State	Zip	Project ID	Final WRI Score	Inspection Date (format: mm/dd/yyyy)
1							
2							
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5							
6							
7							
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1				
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14				
15				
16				
		TOTAL: 0	**TOTAL: 0**	

Summary After FINAL Inspection For Commercial Spaces

Scoring Tool Version: 5.2.20 Revision Date: 2/28/2024

Project ID: None entered on "Overview (Verification)" Sheet
Builder/Applicant: None entered on "Overview (Verification)" Sheet
Address of Home: None entered on "Overview (Verification)" Sheet
Community/Lot #: None entered on "Overview (Verification)" Sheet
Climate Zone: !! !! !! !!

Comm. Space pathway selected: NOT PERSUING COMMERCIAL
Project Description:

There are errors in the Verification Report Sheet!

There is missing mandatory information on this sheet!

NGBS GREEN CERTIFIED • NGBS GREEN CERTIFIED • SAMPLE

NOT PURSUING COMMERCIAL

Client Comments:

Name:
Email:
Phone:
Date:

Verifier Comments:

Name:
Email:
Phone:
Start Time: *(format: hh:mm AM)*
End Time:
Date: *(format: mm/dd/yyyy)*

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	Verifier Name	Role	Elements Verified *(if applicable)*	Inspection Dates *(if applicable)*
1				
2				
3				
4				
5				

OPTIONAL BATCH SUBMISSION

	Final Address	City	State	Zip	Project ID	Final WRI Score	Inspection Date (format: mm/dd/yyyy)
1							
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5							
6							
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APPENDIX B

EXAMPLES OF THIRD-PARTY PROGRAMS FOR INDOOR ENVIRONMENTAL QUALITY

B100 SCOPE AND APPLICABILITY

B101.1 Applicability of Appendix B. Appendix B is not part of this Standard.

B101.2 Scope. Appendix B provides examples of third-party programs for indoor environmental quality that can be used to demonstrate compliance with the applicable provisions of this Standard.

B200 CONFORMANCE

TABLE B200(1)
Examples of Third-party Certification Programs

Related Section of Standard	Examples of Third-party Certification Programs Compliant with the Corresponding Section
901.5 Cabinets	Kitchen Cabinet Manufacturers Association (KCMA) Environmental Stewardship Program (ESP)
901.6 Carpets	Carpet and Rug Institute's (CRI) Green Label Plus Indoor Air Quality Program
901.7 Hard-surface flooring	UL GREENGUARD Gold Resilient Floor Covering Institute's FloorScore Indoor Air Certification Program
901.8 Wall coverings	UL GREENGUARD Gold
	Scientific Certification Systems (SCS) Indoor Advantage Gold Program
901.9 Architectural coatings	UL GREENGUARD Gold
	Scientific Certification Systems (SCS) Indoor Advantage Gold Program
	Green Seal-11 Standard for Paints and Coatings
	UL 2768
901.10 Adhesives and sealants	UL GREENGUARD
	Scientific Certifications Systems (SCS) Indoor Advantage Gold Program
	Carpet and Rug Institute's (CRI) Green Label Plus Indoor Air Quality Program
	Resilient Floor Covering Institute's FloorScore Indoor Air Certification Program
	Green Seal-36 Standard for Adhesives for Commercial Use
901.11 Insulation	UL GREENGUARD Gold Scientific Certifications Systems (SCS) Indoor Advantage Gold Program
901.12 Furniture and Furnishing	UL GREENGUARD Gold Scientific Certifications Systems (SCS) Indoor Advantage Gold Program BIFMA level certification where 7.6.1 and 7.6.2 are proven to be achieved

TABLE B200(2)

Contact Information for the Example Third-party Certification Programs

Third-party Certification Program	Contact Information for the Program Administrator
Kitchen Cabinet Manufacturers Association (KCMA) Environmental Stewardship Program (ESP)	*Kitchen Cabinet Manufacturers Association* *1899 Preston White Drive* *Reston, VA 20191* *www.kcma.org* *(703) 264-1690*
Carpet and Rug Institute's (CRI) Green Label Plus Indoor Air Quality Program	*Carpet and Rug Institute* *730 College Drive* *Dalton, Georgia 30720* *United States of America* *http://www.carpet-rug.org* *(706) 278-3176*
UL GREENGUARD Gold	*Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, IL 60062-2096* *www.ul.com* *(877) 854-3577*
Resilient Floor Covering Institute's FloorScore Indoor Air Certification Program	*Resilient Floor Covering Institute* *115 Broad Street, Suite 201* *LaGrange, Georgia 30240* *http://www.rfci.com*
Scientific Certification Systems (SCS) Indoor Advantage Gold Program	*Scientific Certification Systems* *2000 Powell Street, Suite 600* *Emeryville, California 94608* *http://www.scscertified.com* *(510) 452-8000*
Green Seal-11 Standard for Paints and Coatings	*Green Seal* *1001 Connecticut Avenue, NW, Suite 827* *Washington, DC 20036-5525* *http://www.greenseal.org/* *(202) 872-6400*
UL 2768	*Underwriters Laboratories Inc.* *333 Pfingsten Road* *Northbrook, IL 60062-2096* *www.ul.com* *(877) 854-3577*

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Table 602.1.12

Minimum Roof Overhang for One- & Two-Story Buildings

Inches of Rainfall (1)	Eave Overhang (Inches)	Rake Overhang (Inches)
≤40	12	12
>41 and ≤70	18	12
>70	24	12

(1) Annual mean total rainfall in inches is in accordance with:
Figure 6(2)

For SI: 12 inches = 304.8 mm

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Table 604.1
Recycled Content

Material Percentage Recycled Content	Points For 2 Minor	Points For 2 Major
25% to less than 50%	**1**	**2**
50% to less than 75%	**2**	**4**
more than 75%	**3**	**6**

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Table 610.1.2.1

Product LCA

4 Impact Measures	5 Impact Measures
POINTS	
2	3

back to 610.1.2.2

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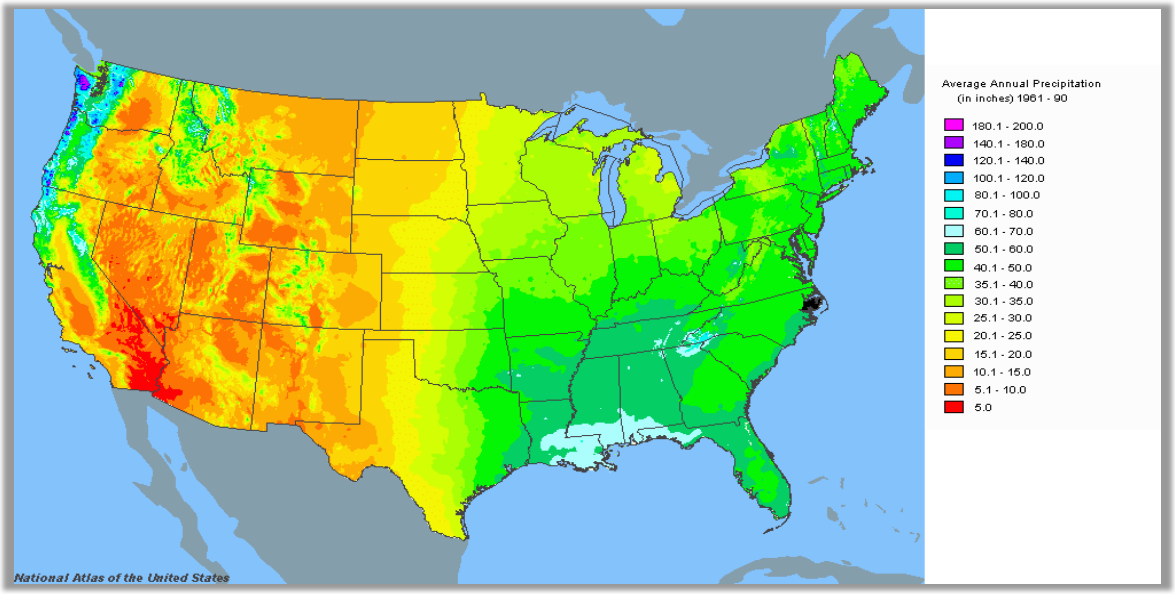
Table 610.1.2.2

Building Assembly LCA

Number of Types of Building Assembly	4 Impact Measures	5 Impact Measures
	POINTS	
2 types	**3**	**6**
3 types	**4**	**8**
4 types	**5**	**10**

Figure 6(2): Average Annual Precipitation

back to 602.1.12 | back to Table 602.1.12 | back to Verification Report



Source: www.nationalatlas.gov

Figure 6(3): Termite Infestation Probability Map

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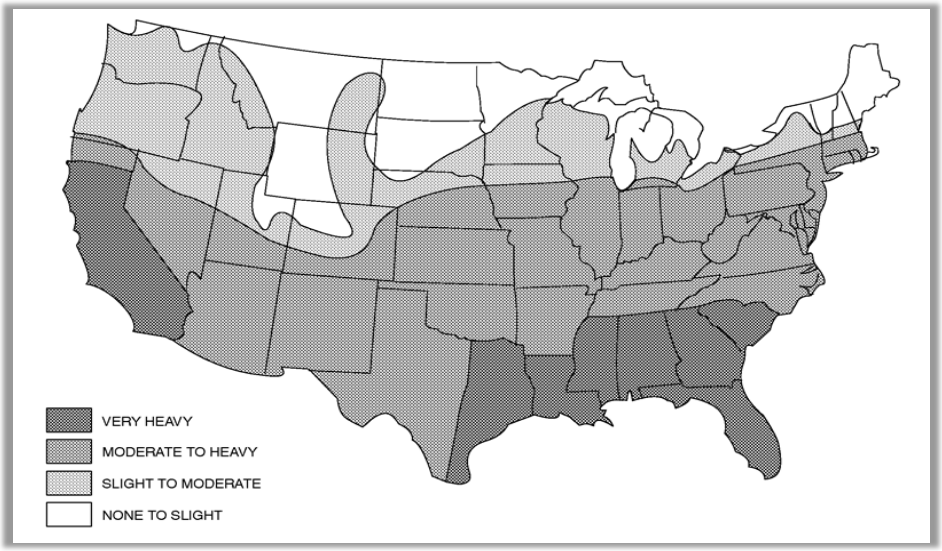

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Table 701.4.3.2(2)
Air Barrier and Insulation Installation

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between window/door jambs and framing, and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include the air barrier.	Rim joists shall be insulated.
Floors (including above garage and cantilevered floors)	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends from the bottom to the top of all perimeter floor framing members.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the showers and tubs.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

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Table 703.2.1(a)

Baseline U-Factors[a]

Climate Zone	Fenestration U- Factor	Skylight U-Factor	Ceiling U-Factor	Frame Wall U-Factor	Mass Wall U-Factor	Floor U-Factor	Basement Wall U-Factor	Crawlspace Wall U-Factor
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.045	0.057	0.028	0.050	0.055

a. Non-fenestration U-factors shall be obtained from measurement, calculation, or an approved source.

b. Where more the half the insulation is on the interior, the mass wall U-factors is a maximum of 0.17 in Zone 1, 0.14 in Zone 2, 0.12 in Zone 3, 0.10 in Zone 4 except in Marine, and the same as the frame wall U-factor in Marine Zone 4 and Zones 5 through 8.

c. Basement wall U-factor of 0.360 in warm-humid locations.

Exception: Tropical Climate Zone, crawl space, basement, floor u-factors are not applicable.

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Table 703.2.1(b)

Points for Improvement in Total Building Thermal Envelope UA

Compared to Baseline UA

Minimum UA Improvement	Climate Zone							
	1[a]	2	3	4	5	6	7	8
	POINTS							
0 to <5%	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
5% to <10%	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
10% to <15%	**3**	**6**	**5**	**6**	**6**	**6**	**5**	**7**
15% to <20%	**5**	**9**	**8**	**9**	**9**	**9**	**8**	**10**
20% to <25%	**6**	**12**	**10**	**12**	**12**	**12**	**11**	**13**
25% to <30%	**8**	**15**	**13**	**16**	**14**	**15**	**14**	**17**
30% to <35%	**10**	**18**	**16**	**19**	**17**	**18**	**16**	**20**
≥35%	**11**	**21**	**18**	**22**	**20**	**21**	**19**	**23**

a. Tropical Climate Zone: Points are Climate Zone 1 points divided by 2 and rounded down

Exception: For the Tropical Climate Zone, crawl space, basement, and floor u-factors are excluded from the total building thermal envelope UA improvement calculation.

back to 703.2.2 back to Verification Report

Table 703.2.2

Exterior Mass Walls

Mass thickness	Climate Zone			
	1-4	5	6	7-8
	POINTS			
≥3 inch to ≥6 inch	**1**	**0**	**0**	**0**
>6 inch	**3**	**2**	**2**	**0**

back to 703.2.4 back to Verification Report

Table 703.2.4(a)

Building Envelope Leakage

Max Envelope Leakage Rate (ACH50)	Climate Zone							
	1	2	3	4	5	6	7	8
	POINTS							
4	**1**	**2**	-	-	-	-	-	-
3	**2**	**4**	-	-	-	-	-	-
2	**3**	**5**	**3**	**4**	**4**	**6**	**8**	**7**
1	**4**	**7**	**5**	**7**	**7**	**10**	**15**	**11**

Table 703.2.4(b)

Building Envelope Leakage

Max Envelope Leakage Rate (ELR50)	Climate Zone							
	1	2	3	4	5	6	7	8
	POINTS							
0.28	**1**	**2**	-	-	-	-	-	-
0.23	**2**	**4**	-	-	-	-	-	-
0.18	**3**	**5**	**3**	**4**	**4**	**6**	**8**	**7**
0.13	**4**	**7**	**5**	**7**	**7**	**10**	**15**	**11**
Where ELR50 = CFM50 / Shell Area								

(Points not awarded if points are taken under Section 705.6.2.1)

back to 703.2.5.1

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Table 703.2.5.1

Fenestration Specifications

Climate Zones	U-Factor	SHGC	U-Factor	SHGC
	Windows and Exterior Doors (maximums certified ratings)		Skylights and TDDs (maximums certified ratings)	
1	0.50	0.25	0.75	0.30
2	0.40	0.25	0.65	0.30
3	0.32	0.25	0.55	0.30
4	0.32	0.40	0.55	0.40
5 to 8	0.30*	Any	0.55	Any

Exception: For Sun-tempered designs meeting the requirements of Section 11.703.7.1, the SHGC is permitted to be 0.40 or higher on south facing glass.

**Exception: A maximum U-factor of 0.32 shall apply in climate zones 5-8 to vertical fenestration products installed in buildings located: (i) above 4000 feet in elevation above sea level or (ii) in windborne debris regions where protection of openings is provided by fenestration as required under IRC section R301.2.1.2.*

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Table 703.2.5.2(a)

Enhanced Fenestration Specifications

Climate Zone	U-Factor Windows & Exterior Doors	SHGC Windows & Exterior Doors	U-Factor Skylights & TDDs	SHGC Skylights & TDDs	POINTS
1	0.40	0.25	0.60	0.28	**1**
2	0.40	0.25	0.60	0.28	**1**
3	0.30	0.25	0.53	0.28	**2**
4	0.30	0.40	0.53	0.35	**3**
5	0.27	Any	0.50	Any	**3**
6	0.27	Any	0.50	Any	**4**
7	0.27	Any	0.50	Any	**4**
8	0.27	Any	0.50	Any	**4**

Exception: For Sun-tempered designs meeting the requirements of Section 703.7.1, the SHGC is permitted to be 0.40 or higher on south facing glass.

Table 703.2.5.2(b)

Enhanced Fenestration Specifications

Climate Zone	U-Factor Windows & Exterior Doors	SHGC Windows & Exterior Doors	U-Factor Skylights & TDDs	SHGC Skylights & TDDs	POINTS
1	0.38	0.25	0.55	0.28	**2**
2	0.38	0.25	0.53	0.28	**3**
3	0.30	0.25	0.50	0.28	**4**
4	0.28	0.40	0.50	0.35	**4**
5	0.25	Any	0.48	Any	**4**
6	0.25	Any	0.48	Any	**5**
7	0.25	Any	0.46	Any	**5**
8	0.25	Any	0.46	Any	**4**

Exception: For Sun-tempered designs meeting the requirements of Section 703.7.1, the SHGC is permitted to be 0.40 or higher on south facing glass.

Table 703.2.5.2(c)

Enhanced Fenestration Specifications

Climate Zone	U-Factor Windows & Exterior Doors	SHGC Windows & Exterior Doors	U-Factor Skylights & TDDs	SHGC Skylights & TDDs	POINTS
4	0.25	0.40	0.45	0.40	**6**
5-8	0.22	Any	0.42	Any	**6**

(Points for multifamily buildings four or more stories in height are awarded at 3 times the point value listed in Table 703.2.5.2(c))

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Table 703.7.1(7)

South-Facing Window Overhang Depth

		Vertical distance between bottom of overhang and top of window sill				
		≤7' 4"	≤6' 4"	≤5' 4"	≤4' 4"	≤3' 4"
Climate Zone	1 & 2 & 3	2' 8"	2' 8"	2' 4"	2' 0"	2' 0"
	4 & 5 & 6	2' 4"	2' 4"	2' 0"	2' 0"	1' 8"
	7 & 8	2' 0"	1' 8"	1' 8"	1' 4"	1' 0"

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Table 802.1(1)

Maximum Pipe Length Conversion Table[a]

Nominal Pipe Size (inch)	Liquid Ounces per Foot of Length	Main, Branch, and Fixture Supply System Volume Category			Branch and Fixture Supply Volume from Circulation Loop
		128 ounces (1 gallons) [per 802.1(1)]	64 ounces (0.5 gallon) [per 802.1(2)]	32 ounces (0.25 gallon) [per 802.1(3)]	24 ounces (0.19 gallons [per 802.1(4)]
		Maximum Pipe Length (feet)			
1/4[b]	0.33	50	50	50	50
5/16[b]	0.5	50	50	50	48
3/8[b]	0.75	50	50	43	32
1/2	1.5	50	43	21	16
5/8	2	50	32	16	12
3/4	3	43	21	11	8
7/8	4	32	16	8	6
1	5	26	13	6	5
1 1/4	8	16	8	4	3
1 1/2	11	12	6	3	2
2	18	7	4	2	1

a. Maximum pipe length figures apply when the entire pipe run is one nominal diameter only. Where multiple pipe diameters are used, the combined volume shall not exceed the volume limitation in Section 802.1.

b. The maximum flow rate through 1/4 inch nominal piping shall not exceed 0.5 gpm. The maximum flow rate through 5/16 inch nominal piping shall not exceed 1 gpm. The maximum flow rate through 3/8 inch nominal piping shall not exceed 1.5 gpm.

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Table 802.1(2)

Common Hot Water Pipe Internal Volumes

OUNCES OF WATER PER FOOT OF PIPE

Size Nominal, Inch	Copper Type M	Copper Type L	Copper Type K	CPVC CTS SDR 11	CPVC SCH 40	CPVC SCH 80	PE-RT SDR 9	Composite ASTM F 1281	PEX CTS SDR 9	PP SDR 7.4	PP SDR 9
3/8	1.06	0.97	0.84	N/A	1.17	N/A	0.64	0.63	0.64	N/A	N/A
1/2	1.69	1.55	1.45	1.25	1.89	1.46	1.18	1.31	1.18	1.72	1.96
3/4	3.43	3.22	2.90	2.67	3.38	2.74	2.35	3.39	2.35	2.69	3.06
1	5.81	5.49	5.17	4.43	5.53	4.57	3.91	5.56	3.91	4.41	5.01
1 ¼	8.7	8.36	8.09	6.61	9.66	8.24	5.81	8.49	5.81	6.90	7.83
1 ½	12.18	11.83	11.45	9.22	13.2	11.38	8.09	13.88	8.09	10.77	12.24
2	21.08	20.58	20.04	15.79	21.88	19.11	13.86	21.48	13.86	17.11	19.43

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Table 901.9.1

VOC Content Limits For Architectural Coatings[a,b,c]

Coating Category	LIMIT[d] (g/l)
Flat Coatings	50
Non-flat Coatings	100
Non-flat High-Gloss Coatings	150
Specialty Coatings:	
Aluminum Roof Coatings	400
Basement Specialty Coatings	400
Bituminous Roof Coatings	50
Bituminous Roof Primers	350
Bond Breakers	350
Concrete Curing Compounds	350
Concrete/Masonry Sealers	100
Driveway Sealers	50
Dry Fog Coatings	150

Coating Category	LIMIT[d] (g/l)
Faux Finishing Coatings	350
Fire Resistive Coatings	350
Floor Coatings	100
Form-Release Compounds	250
Graphic Arts Coatings (Sign Paints)	500
High Temperature Coatings	420
Industrial Maintenance Coatings	250
Low Solids Coatings	120[e]
Magnesite Cement Coatings	450
Mastic Texture Coatings	100
Metallic Pigmented Coatings	500
Multi-Color Coatings	250
Pre-Treatment Wash Primers	420
Primers, Sealers, and Undercoaters	100
Reactive Penetrating Sealers	350
Recycled Coatings	250
Roof Coatings	50
Rust Preventative Coatings	250
Shellacs, Clear	730
Shellacs,□ Opaque	550
Specialty Primers, Sealers, and Undercoaters	100
Stains	250
Stone Consolidants	450
Swimming Pool Coatings	340
Traffic Marking Coatings	100
Tub and Tile Refinish Coatings	420
Waterproofing Membranes	250
Wood Coatings	275
Wood Preservatives	350
Zinc-Rich Primers	340

a. The specified limits remain in effect unless revised limits are listed in subsequent columns in the table.

b. Values in this table are derived from those specified by the California Air Resources Board, Architectural Coatings Suggested Control Measure, February 1, 2008.

c. Table 901.9.1 architectural coating regulatory category and VOC content compliance determination shall conform to the California Air Resources Board Suggested Control Measure for Architectural Coatings dated February 1, 2008.

d. Limits are expressed as VOC Regulatory (except as noted), thinned to the manufacturer's maximum thinning recommendation, excluding any colorant added to tint bases.

e. Limit is expressed as VOC actual.

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Table 901.9.2

VOC Content Limits for Colorants

Colorant	LIMIT (g/l)
Architectural Coatings, excluding IM Coatings	50
Solvent-Based IM	600
Waterborne IM	50

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Table 901.10(3)

Site Applied Adhesive and Sealants VOC Limits[a,b]

ADHESIVE OR SEALANT	VOC LIMIT (g/l)
Indoor carpet adhesives	50
Carpet pad adhesives	50
Outdoor carpet adhesives	150
Wood flooring adhesive	100
Rubber floor adhesives	60
Subfloor adhesives	50
Ceramic tile adhesives	65
VCT and asphalt tile adhesives	50
Drywall and panel adhesives	50
Cove base adhesives	50
ADHESIVE OR SEALANT	**VOC LIMIT (g/l)**
Multipurpose construction adhesives	70
Structural glazing adhesives	100
Single ply roof membrane adhesives	250
Architectural sealants	250
Architectural sealant primer	
Non-porous	250
Porous	775
Modified bituminous sealant primer	500
Other sealant primers	750
CPVC solvent cement	490
PVC solvent cement	510
ABS solvent cement	325
Plastic cement welding	250
Adhesive primer for plastic	550
Contact adhesive	80
Special purpose contact adhesive	250
Structural wood member adhesive	140

a. VOC limit less water and less exempt compounds in grams/liter

b. For low-solid adhesives and sealants, the VOC limit is expressed in grams/liter of material as specified in Rule 1168. For all other adhesives and sealants, the VOC limits are expressed as grams of VOC per liter of adhesive or sealant less water and less exempt compounds as specified in Rule 1168.

version	release date	correction
5.0.0	4/20/2020	initial release
5.0.1	4/23/2020	fixed some missing dropdowns
5.0.2	5/3/2020	bug fix
5.0.3	5/10/2020	fixed rough comm. sig. dropdowns, added "Exempt" to 703.4.4, changed text of 703.6.1, 704.2 redone, 802.10.1 added.
5.0.4	5/26/2020	fixed ch. 7 design max level
5.0.5	7/7/2020	updated copyright date, added WRI sheets, added Badges sheets, updated appendices
5.0.6	7/29/2020	erroring related to 703.1.2, added energy modeler fields, fixed error in points available for 503.5 in Verification Report, removed WRI
5.0.7	8/21/2020	701.1 note mandatory indication fixed in Ver. Rep., 503.7 multiselect changed to dropdown, corrected various availability logic, fixed 705/706 count rough error
5.0.8	8/30/2020	finalized Wellness Badge changes
5.1.0	9/17/2020	corrected 609.1 in Commercial
5.1.1	9/18/2020	corrected Wellness Badge requirements
5.1.2	9/27/2020	fixed mandatory note indication for 602.1.15 on Verification page, corrected 505.6 availability to MF only, Resilience Badge requirements corrected
5.1.3	10/25/2020	backend fix, removed some page breaks from Verification Report, test result field added to 902.3.2(1), energy modeler field added, corrected error logic for 802.6.1
5.1.4	11/24/2020	corrected availability logic in Chapter 8 Verification Report, added "other" to modeler credential
5.1.5	1/5/2021	902.3(2) points now automatic, fixed some Wellness badge qualification logic, backend changes
5.2.1	2/16/2021	logic fixes for Smart Home and Wellness Badges, elevation field on design pages and relevant warnings in Ch 7, additional detail entry for 701.1.4, corrected points for 501.2(4)(b)
5.2.2	3/5/2021	fixed points error on 501.1, added WaterSense
5.2.3	4/2/2021	Removed Verifier Reminder
5.2.4	5/12/2021	corrected Mandatory indication for 701.4.3.1; 703.2.5 not mandatory for Tropical, corrected error indication on Rough Comm. Sig. page
5.2.5	8/8/2021	corrected informational display of unit count for 706.5, increased maximum allowed answer for 706.5(3), 602.1.1.1 now allows "N/A" with mandatory note, 703.1.3 test results now need to be entered, 11.705.2.4 no longer available if there are no heating or cooling systems
5.2.6	8/26/2021	corrected an error that excluded the ERI path in Ch 7 from Emerald
5.2.7	11/11/2021	Solar Thermal and Geothermal sections added to Net Zero Energy badge, SF exception added to Wellness badge, signatures removed and page names changed
" "		Corrected some Ch 7 calculations to check for >= 4 stories rather than >4 stories, 703.1.3 no longer requires test results when testing not required, 703.1 points no longer awarded in Tropical Zone
5.2.8	2/1/2022	Corrected leakage display for 703.2.4, 13.104.1.9 changed to Core & Shell, 902.3.1 is now considered passive and has had its points adjusted
" "		703.1.2 no longer unavailable when 701.4.3.3 exception selected
5.2.9	9/6/2022	added Dominican Republic to location options; corrected text of 802.4(2), 13.105.5, 13.105.6, and 13.105.11.3; changed 505.3 to dropdown; added note to 13.105.8.1
5.2.10	11/22/2022	Corrected Points Filter for 505.6; Corrected final level capping for "Alternate Bronze"
5.2.11	1/19/2023	Added GRESB sheets, adjusted error logic for 901.13, 905.5 number corrected
5.2.12	2/21/2023	corrected points calc for 1002.5
5.2.13	4/13/2023	corrected points formula for 602.1.12, added new GRESB section
5.2.14	5/25/2023	fixed a broken Excel link; some minor indicating text added or adjusted; 703.1.2 ELR limit now considers number of stories; sampling now allowed for SF build-to-rent
5.2.15	6/14/2023	corrected some edge-case final level calculation, corrected max ACH and ELR for 703.1.2
5.2.16	9/19/2023	updated 902.3 in Commercial to match residential 902.3, corrected mandatory erroring for 901.3(1)(b)
5.2.17	1/18/2024	GRESB backend changes; added missing mandatory flags for 703.1.2 and 703.1.3; added new notes field for Net Zero Energy Badge; adjusted point calculation for 802.5.1
" "		added indication of Build-to-Rent; 505.9 available for BTR SF; 505.5, 505.6, 505.7 now available for all SF
5.2.18	1/29/2024	updated Req. Doc. Sheet
5.2.19	2/9/2024	corrected mandatory requirements for 701.4.3.2(1), restricted availability of 901.1.2
5.2.20	2/28/2024	corrected availability of 901.1.2