

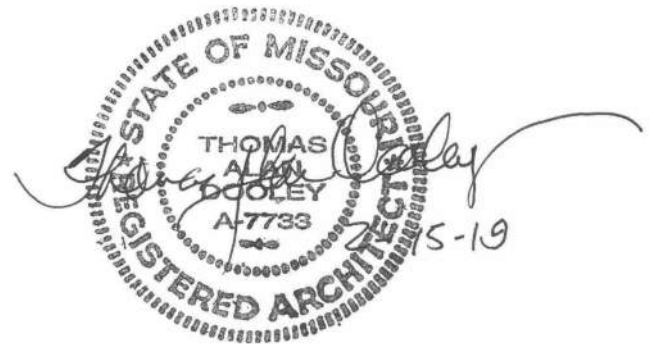
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HEREFORD·DOOLEY
ARCHITECTS

Project Manual for the
**Lee's Summit Medical Center
Medical Office Building**

2100 SE Blue Parkway
Lee's Summit, MO 64063



Construction Documents Set
HD Project No.: 217026.05
Date: 02-15-2019

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SEALS PAGE

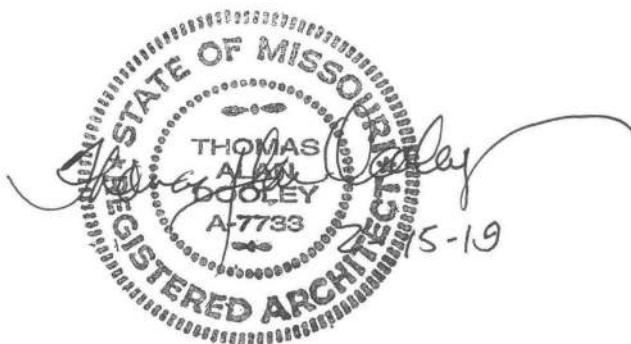


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SECTION 01 10 00
SUMMARY

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Lee's Summit MOB - Rev
- B. Architect's Name: Hereford Dooley Architects.
- C. The Project consists of the construction of a 3-story Medical Office Building, of approximately 60,000 SF on the campus of Lee's Summit Medical Center..

1.02 CONTRACT DESCRIPTION

1.03 WORK BY OWNER

- A. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Substantial Completion. Some items include:
 - 1. Furnishings.
 - 2. Small equipment.
 - 3. Artwork.

1.04 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Arrange use of site and premises to allow:
 - 1. Owner occupancy.
 - 2. Work by Others.
- C. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

- A. Section 00 50 00 - Contracting Forms and Supplements: Forms to be used.

1.03 SCHEDULE OF VALUES

- A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
- F. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- G. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- H. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.
 - 4. Previous Applications.
 - 5. Work in Place and Stored Materials under this Application.
 - 6. Authorized Change Orders.
 - 7. Total Completed and Stored to Date of Application.
 - 8. Percentage of Completion.
 - 9. Balance to Finish.
 - 10. Retainage.
- F. Execute certification by signature of authorized officer.
- G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

- H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
- I. Submit one electronic and three hard-copies of each Application for Payment.
- J. Include the following with the application:
 - 1. Transmittal letter as specified for submittals in Section 01 30 00.
 - 2. Construction progress schedule, revised and current as specified in Section 01 30 00.
 - 3. Partial release of liens from major subcontractors and vendors.
 - 4. Affidavits attesting to off-site stored products.
- K. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.05 MODIFICATION PROCEDURES

- A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to the Contract Documents.
- B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- C. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 - 2. Promptly execute the change.
- D. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 10 days.
- E. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 60 00.
- F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 - 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
 - 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
 - 3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
 - 4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- G. Substantiation of Costs: Provide full information required for evaluation.
 - 1. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
- H. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

- J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- K. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 01 70 00.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Electronic document submittal service.
- C. Preconstruction meeting.
- D. Site mobilization meeting.
- E. Progress meetings.
- F. Construction progress schedule.
- G. Progress photographs.
- H. Submittals for review, information, and project closeout.
- I. Number of copies of submittals.
- J. Requests for Interpretation (RFI) procedures.
- K. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: General product requirements.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Architect:
 - 1. Requests for Interpretation (RFI).
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.
 - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - 11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. Contractor and Architect are required to use this service.
 - 3. It is Contractor's responsibility to submit documents in allowable format.

4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the Contract Sum.
- C. Submittal Service: The selected service is:
1. Submittal Exchange (tel: 1-800-714-0024): www.submittalexchange.com.
- D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
- E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

- A. Schedule meeting after Notice of Award.
- B. Attendance Required:
1. Owner.
 2. Architect.
 3. Contractor.
 4. Hospital Representatives.
- C. Agenda:
1. Execution of Owner-Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 5. Designation of personnel representing the parties to Contract, and Architect.
 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 7. Scheduling.
 8. Scheduling activities of a Geotechnical Engineer.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING

- A. Schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's superintendent.
 5. Major subcontractors.
 6. Hospital Representatives.
- C. Agenda:
1. Use of premises by Owner and Contractor.
 2. Owner's requirements.

3. Construction facilities and controls provided by Owner.
 4. Temporary utilities provided by Owner.
 5. Survey and building layout.
 6. Security and housekeeping procedures.
 7. Schedules.
 8. Application for payment procedures.
 9. Procedures for testing.
 10. Procedures for maintaining record documents.
 11. Requirements for start-up of equipment.
 12. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the work at maximum monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
 1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's superintendent.
 5. Major subcontractors.
- D. Agenda:
 1. Review minutes of previous meetings.
 2. Review of work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Review of RFIs log and status of responses.
 7. Maintenance of progress schedule.
 8. Corrective measures to regain projected schedules.
 9. Planned progress during succeeding work period.
 10. Coordination of projected progress.
 11. Maintenance of quality and work standards.
 12. Effect of proposed changes on progress schedule and coordination.
 13. Other business relating to work.
- E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

3.06 PROGRESS PHOTOGRAPHS

- A. Submit new photographs at least once a month, within 3 days after being taken.
- B. Photography Type: Digital; electronic files.
- C. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.
- D. In addition to periodic, recurring views, take photographs of each of the following events:
 - 1. Completion of site clearing.
 - 2. Excavations in progress.
 - 3. Foundations in progress and upon completion.
 - 4. Structural framing in progress and upon completion.
 - 5. Enclosure of building, upon completion.
 - 6. Final completion, minimum of ten (10) photos.
- E. Views:
 - 1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
 - 2. Consult with Architect for instructions on views required.
 - 3. Provide factual presentation.
 - 4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
- F. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
 - 1. Delivery Medium: Via email.
 - 2. File Naming: Include project identification, date and time of view, and view identification.
 - 3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
 - 4. Photo CD(s): Provide 1 copy including all photos cumulative to date and PDF file(s), with files organized in separate folders by submittal date.

3.07 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in the Contract Documents.
 - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of the Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 - 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 - 2. Prepare using software provided by the Electronic Document Submittal Service.
 - 3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 - 1. Include in each request Contractor's signature attesting to good faith effort to determine from the Contract Documents information requiring interpretation.

2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
 - a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 01 60 00 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response.
4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, the Contract Documents, with no additional input required to clarify the question. They will be returned without a response.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 2. Owner's, Architect's, and Contractor's names.
 3. Discrete and consecutive RFI number, and descriptive subject/title.
 4. Issue date, and requested reply date.
 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
 1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 2. Note dates of when each request is made, and when a response is received.
 3. Highlight items requiring priority or expedited response.
 4. Highlight items for which a timely response has not been received to date.
- H. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
 1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
 1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.

2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.08 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 1. Submit at the same time as the preliminary schedule specified in Section - 01 32 16 - Construction Progress Schedule.
 2. Coordinate with Contractor's construction schedule and schedule of values.
 3. Format schedule to allow tracking of status of submittals throughout duration of construction.
 4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.09 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Shop drawings.
 3. Samples for selection.
 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.10 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 1. Design data.
 2. Certificates.
 3. Test reports.
 4. Inspection reports.
 5. Manufacturer's instructions.
 6. Manufacturer's field reports.
 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.11 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
 1. Project record documents.

2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.12 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 1. After review, produce duplicates.
 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.13 SUBMITTAL PROCEDURES

- A. General Requirements:
 1. Use a separate transmittal for each item.
 2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
 3. Transmit using approved form.
 - a. Use form generated by Electronic Document Submittal Service software.
 4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 7. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Upload submittals in electronic form to Electronic Document Submittal Service website.
 8. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
 9. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 10. Provide space for Contractor and Architect review stamps.
 11. When revised for resubmission, identify all changes made since previous submission.
 12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 14. Submittals not requested will be recognized, and will be returned "Not Reviewed",
- B. Product Data Procedures:
 1. Submit only information required by individual specification sections.
 2. Collect required information into a single submittal.
 3. Submit concurrently with related shop drawing submittal.

4. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related work.
 2. Do not reproduce the Contract Documents to create shop drawings.
 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
 1. Transmit related items together as single package.
 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
 3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.
- E. Transmit each submittal with approved form.

3.14 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
- D. Architect's and consultants' actions on items submitted for review:
 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved", or language with same legal meaning.
 - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
 - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
 - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
 - 2) Non-responsive resubmittals may be rejected.
 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit".
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - 2) Non-responsive resubmittals may be rejected.
 - b. "Rejected".
 - 1) Submit item complying with requirements of Contract Documents.
- E. Architect's and consultants' actions on items submitted for information:
 1. Items for which no action was taken:
 - a. "Received" - to notify the Contractor that the submittal has been received for record only.
 2. Items for which action was taken:
 - a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

1.02 REFERENCE STANDARDS

- A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.
- B. M-H (CPM) - CPM in Construction Management - Project Management with CPM; O'Brien; 2006.

1.03 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

1.04 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1.05 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Sheet Size: Multiples of 8-1/2 x 11 inches.
- C. Scale and Spacing: To allow for notations and revisions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Identify work of separate stages and other logically grouped activities.
- D. Provide sub-schedules to define critical portions of the entire schedule.
- E. Include conferences and meetings in schedule.
- F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- G. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.

- H. Indicate delivery dates for owner-furnished products.
- I. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

3.04 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

3.05 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. References and standards.
- D. Testing and inspection agencies and services.
- E. Contractor's construction-related professional design services.
- F. Control of installation.
- G. Mock-ups.
- H. Tolerances.
- I. Manufacturers' field services.
- J. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Section 01 42 16 - Definitions.

1.03 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2014).
- B. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2014.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2013.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing; 2014a.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2013.
- G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
- H. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2010.

1.04 DEFINITIONS

- A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.
- B. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
 - 1. Design Services Types Required:
 - a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor's sole responsibilities for construction means, methods, techniques, sequences, and procedures.
 - b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.

- C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
 - 1. Temporary sheeting, shoring, or supports.
 - 2. Temporary scaffolding.
 - 3. Temporary bracing.
 - 4. Temporary foundation underpinning.
 - 5. Temporary stairs or steps required for construction access only.
 - 6. Temporary hoist(s) and rigging.
 - 7. Investigation of soil conditions to support construction equipment.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the contract documents, or for Owner's information.
- C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
 - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
 - 1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the contract documents.
- G. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
 - 1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the contract documents.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in Missouri.
- C. Contractor's Quality Control (CQC) Plan:
 - 1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
 - a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
 - 1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
 - b. Owner will not make a separate payment for providing and maintaining a Quality Control Plan. Include associated costs in Bid price.

1.08 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.09 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:
 - 1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM E699, ASTM C1021, ASTM C1077, ASTM C1093, and ASTM D3740.
 - 2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
 - 3. Laboratory Qualifications: Accredited by IAS according to IAS AC89.
 - 4. Laboratory: Authorized to operate in Missouri.
 - 5. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
 - 6. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
- D. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.
- E. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- F. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- G. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- H. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
- I. Accepted mock-ups shall be a comparison standard for the remaining Work.
- J. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

- A. Testing Agency Duties:

1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 2. Perform specified sampling and testing of products in accordance with specified standards.
 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 5. Perform additional tests and inspections required by Architect.
 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect 30 days in advance of required observations.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 42 16
DEFINITIONS

PART 1 GENERAL

1.01 SUMMARY

- A. This section supplements the definitions contained in the General Conditions.
- B. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.
- E. Provide: To furnish and install.
- F. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 45 33
CODE-REQUIRED SPECIAL INSPECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Code-required special inspections.
- B. Testing services incidental to special inspections.
- C. Submittals.

1.02 RELATED REQUIREMENTS

- A. Section 01 45 24 - Structural Special Inspections

1.03 DEFINITIONS

- A. Code or Building Code: ICC (IBC), 2015 Edition of the International Building Code and specifically, Chapter 17 - Special Inspections and Tests.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- C. National Institute of Standards and Technology (NIST).
- D. Special Inspection:
 - 1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved contract documents and the referenced standards.
 - 2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

1.04 REFERENCE STANDARDS

- A. AISC 341 - Seismic Provisions for Structural Steel Buildings; 2010.
- B. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
- C. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing; 2014a.
- D. ASTM E2570/E2570M - Standard Test Methods for Evaluating Water-Resistive Barrier (WRB) Coatings Used under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage; 2007 (2014)e1.
- E. ICC (IBC) - International Building Code; 2015.

1.05 SUBMITTALS

- A. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency shall:
 - 1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 - 3. Submit certification that Special Inspection Agency is acceptable to AHJ.
- B. Testing Agency Qualifications: Prior to the start of work, the Testing Agency shall:
 - 1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.

2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 3. Submit certification that Testing Agency is acceptable to AHJ.
- C. Fabricator's Qualification Statement: Fabricator shall submit documentation of fabrication facilities and methods as well as quality control procedures. Include documentation of AHJ approval.
- D. Special Inspection Reports: After each special inspection, Special Inspector shall promptly submit two copies of report; one to Architect and one to the AHJ.
- E. Test Reports: After each test or inspection, promptly submit two copies of report; one to Architect and one to AHJ.
1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test or inspection.
 - h. Date of test or inspection.
 - i. Results of test or inspection.
 - j. Compliance with Contract Documents.

1.06 SPECIAL INSPECTION AGENCY

- A. Owner or Architect will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by the building code.
- B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.07 TESTING AND INSPECTION AGENCIES

- A. Owner or Architect may employ services of an independent testing agency to perform additional testing and sampling associated with special inspections but not required by the building code.
- B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL

- A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
 1. Continuous Special Inspection: Special Inspection Agency shall be present in the area where the work is being performed and observe the work at all times the work is in progress.
 2. Periodic Special Inspection: Special Inspection Agency shall be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

3.02 SPECIAL INSPECTIONS FOR SOILS

- A. Materials and Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
 1. Design bearing capacity of material below shallow foundations; periodic.
 2. Design depth of excavations and suitability of material at bottom of excavations; periodic.
 3. Materials, densities, lift thicknesses; placement and compaction of backfill: continuous.
 4. Subgrade, prior to placement of compacted fill; periodic.

- B. Testing: Classify and test excavated material; periodic.

3.03 SPECIAL INSPECTIONS FOR EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS)

- A. Verify water resistive barrier coating applied over sheathing complies with ASTM E2570.

3.04 SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE

- A. Structural Steel: Comply with the quality assurance plan requirements of AISC 341.
- B. Cold Formed Steel Light Frame Construction:
 - 1. Field welding; periodic.
 - 2. Screw attachment, bolting, anchoring and other fastening of components within the main seismic force-resisting system; periodic.
- C. Architectural Components: Erection and fastening of components below; periodic.
 - 1. Exterior cladding.
- D. Mechanical and Electrical Components:
 - 1. Anchorage of electric equipment required for emergency or standby power systems; periodic.
 - 2. Installation and anchorage of other electrical equipment; periodic.
 - 3. Vibration isolation systems where the approved contract documents require a nominal clearance of 1/4 inch or less between support frame and seismic restraint; periodic.
- E. Designated Seismic System Verification: Verify label, anchorage or mounting complies with certificate of compliance provided by manufacturer or fabricator.
- F. Structural Observations for Seismic Resistance: Visually observe structural system for general compliance with the approved contract documents; periodic.

3.05 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

- A. Special Inspection Agency shall:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified reference standards.
 - 3. Ascertain compliance of materials and products with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests or inspections specified.
- B. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- C. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.06 TESTING AGENCY DUTIES AND RESPONSIBILITIES

- A. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests or inspections specified.
- B. Limits on Testing or Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.

2. Agency may not approve or accept any portion of the work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the work.
- C. On instructions by Architect, perform re-testing required because of non-compliance with specified requirements, using the same agency.
- D. Contractor will pay for re-testing required because of non-compliance with specified requirements.

3.07 CONTRACTOR DUTIES AND RESPONSIBILITIES

- A. Contractor Responsibilities, General:
1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
 2. Cooperate with agency and laboratory personnel; provide access to the work, to manufacturers' facilities, and to fabricators' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to work to be tested or inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
 - c. To facilitate tests or inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
 5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- B. Contractor Responsibilities, Seismic Force-Resisting Systems: Submit written statement of responsibility for each item listed to AHJ and Owner prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary sanitary facilities.
- C. Temporary Controls: Barriers, enclosures, and fencing.
- D. Security requirements.
- E. Waste removal facilities and services.
- F. Field offices.

1.02 RELATED REQUIREMENTS

- A. Section 01 58 13 - Temporary Project Signage.

1.03 TEMPORARY UTILITIES

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- B. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.04 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. New permanent facilities may not be used during construction operations.
- C. Maintain daily in clean and sanitary condition.
- D. At end of construction, return facilities to same or better condition as originally found.

1.05 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING

- A. Construction: Solid wood fence, painted.
- B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.07 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.08 SECURITY

- A. Provide security and facilities to protect Work, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program.

1.09 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.10 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.11 PROJECT SIGNS - SEE SECTION 01 58 13

1.12 FIELD OFFICES

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.13 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.
- E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 58 13
TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project identification sign.
- B. Project informational signs.

1.02 REFERENCE STANDARDS

- A. FHWA (SHS) - Standard Highway Signs; Federal Highway Administration; 2004.

1.03 QUALITY ASSURANCE

- A. Design sign and structure to withstand 50 miles/hr wind velocity.
- B. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

PART 2 PRODUCTS

2.01 SIGN MATERIALS

- A. Structure and Framing: New, wood, structurally adequate.
- B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch thick, standard large sizes to minimize joints.
- C. Rough Hardware: Galvanized.
- D. Lettering: Exterior quality paint, contrasting colors.

2.02 PROJECT IDENTIFICATION SIGN

- A. One painted sign, 48 sq ft area, bottom 6 feet above ground.
- B. Content:
 - 1. Project number, title, logo and name of Owner as indicated on Contract Documents.
 - 2. Names and titles of authorities.
 - 3. Names and titles of Architect and Consultants.
 - 4. Name of Prime Contractor and major Subcontractors.
- C. Graphic Design, Colors, Style of Lettering: Designated by Architect.
- D. Lettering: Standard Alphabet Series C, as specified in FHWA (SHS).

2.03 PROJECT INFORMATIONAL SIGNS

- A. Painted informational signs of same colors and lettering as Project Identification sign, or standard products; size lettering to provide legibility at 100 foot distance.
- B. Provide at each field office, storage shed, and directional signs to direct traffic into and within site. Relocate as Work progress requires.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
- B. Erect at location of high public visibility adjacent to main entrance to site.
- C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
- D. Install sign surface plumb and level, with butt joints. Anchor securely.

- E. Paint exposed surfaces of sign, supports, and framing.

3.02 MAINTENANCE

- A. Maintain signs and supports clean, repair deterioration and damage.

3.03 REMOVAL

- A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations.
- E. Procedures for Owner-supplied products.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- C. Section 01 74 19 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Containing lead, cadmium, or asbestos.
- C. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 01 61 16.
 - 2. If wet-applied, have lower VOC content, as defined in Section 01 61 16.
 - 3. Have longer documented life span under normal use.
 - 4. Result in less construction waste. See Section 01 74 19
 - 5. Are Cradle-to-Cradle Certified.

2.02 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 01 25 00 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

- A. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
 - 1. Review Owner reviewed shop drawings, product data, and samples.
 - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - 3. Handle, store, install and finish products.
 - 4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide off-site storage and protection when site does not permit on-site storage or protection.

- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.
- I. Do not store products directly on the ground.
- J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- L. Prevent contact with material that may cause corrosion, discoloration, or staining.
- M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- N. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Cutting and patching.
- D. Surveying for laying out the work.
- E. Cleaning and protection.
- F. Starting of systems and equipment.
- G. Demonstration and instruction of Owner personnel.
- H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.

1.03 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in Missouri and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

1.04 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
 - 1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
 - 2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
- F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- G. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
 - 1. Pest Control Service: Weekly treatments.
- H. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

- I. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.05 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.

- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Control datum for survey is that established by Owner provided survey.
- E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- H. Utilize recognized engineering survey practices.
- I. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- K. Periodically verify layouts by same means.
- L. Maintain a complete and accurate log of control and survey work as it progresses.
- M. On completion of foundation walls and major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.

- B. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.
- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing.
- D. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.
- I. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site daily and dispose off-site; do not burn or bury.

3.08 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

3.11 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.12 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Replace filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.13 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Owner.

- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

END OF SECTION

SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

PART 1 GENERAL

1.01 POLICY

- A. HCA's policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy the Contractor shall: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. HCA's goal is zero waste, however, we realize that some waste will occur on a project building site that cannot be reduced or recycled. Therefore, contractors shall divert 95% of total project waste from the landfill.

1.02 REFERENCES

- A. HCA's policy requires a minimum landfill diversion of 95% of all construction and demolition debris. For additional references to diversion from landfills see www.usgbc.org, Materials and Resources, Credit 2. Contractor should become familiar with LEED reporting requirements in the event that HCA chooses to pursue LEED certification for an individual project.
- B. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
 - 1. ASTM INTERNATIONAL (ASTM)
 - a. ASTM E 1609 (2001) Development and Implementation of a Pollution Prevention Program
 - 2. U.S. GREEN BUILDING COUNCIL (USGBC)
 - a. (2002; R 2005; 2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.03 DEFINITIONS

- A. Comingled vs Source Separated C&D Debris - Comingled debris is material that mixes all types of construction and demolition material in one container. Source separated, keeps several or all materials segregated from each other. Benefits of comingling include reduced labor and no need for education, and space saving. Benefits of source separation are higher value material due to lack of contamination, opportunity to involve labor and ability to use materials such as gypsum, masonry and rock product on site.
- B. Construction and Demolition Debris - uncontaminated solid waste resulting from the construction, remodeling, repair and demolition of utilities, structures and roads; and uncontaminated solid waste resulting from land clearing. Such waste includes, but is not limited to bricks, concrete and other masonry materials, soil, rock, wood (including painted, treated and coated wood and wood products), land clearing debris, wall coverings, plaster, drywall, plumbing fixtures, non-asbestos insulation, roofing shingles and other roof coverings, asphaltic pavement, glass, plastics that are not sealed in a manner that conceals other wastes, empty buckets ten gallons or less in size and having no more than one inch of residue remaining on the bottom, electrical wiring and components containing no hazardous liquids, and pipe and metals that are incidental to any of the above. Solid waste that is not C&D debris (even if resulting from the construction, remodeling, repair and demolition of utilities, structures and roads and land clearing) includes, but is not limited to asbestos waste, garbage, any item containing hazardous materials such as fluorescent light ballasts or transformers, fluorescent lights, tires, drums, containers greater than ten gallons in size, any containers having more than one inch of residue remaining on the bottom and fuel tanks. Specifically excluded from the definition of construction and demolition debris is solid waste (including what otherwise would be construction and demolition debris) resulting from any processing technique that renders individual waste components unrecognizable, such as pulverizing or shredding.
- C. Debris Management Coordinator (DMC) - The contractor must appoint a DMC to oversee the activities relating to managing C&D debris on the site. The DMC will complete and submit the

Waste Management Plan (form B) and collect records and data supporting disposal and diversion amounts.

- D. Land Clearing Debris - Is vegetative matter, soil and rock resulting from activities such as land clearing and grubbing, utility line maintenance or seasonal or storm-related cleanup such as trees, stumps, brush and leaves and including wood chips generated from these materials. Land clearing debris does not include yard waste that has been collected at the curb.
- E. Landfill Diversion - Means keeping material out of the landfill by reducing the amount of waste produced, reusing material, recycling, composting, incineration, or other mean.
- F. Recycle - To process materials so that they may be used again. They can be used for their original purpose or another. Recycling is less preferable than reduction or reuse because often the processing takes up to 60% of the energy to transport and remake the new item. Example: pulverizing drywall as a soil amendment.
- G. Reuse - Using an item again for the same purpose. Example: reusable pallets.
- H. Source Reduction - The act of decreasing waste or the toxicity of waste. Examples: Waste reduction - Ordering wallboard to the correct height and using cutoffs to fill holes. Reduced toxicity - paint that contains no VOCs.
- I. Waste prevention - Not creating waste through concepts such as source reduction, recycling, composting and reuse.
- J. The following is a partial list of C&D debris materials. The project waste may include but is not limited to these materials.
 - 1. Asphalt
 - 2. Bricks
 - 3. Carpet and carpet pad
 - 4. Corrugated cardboard
 - 5. Clean dimensional wood
 - 6. Wood (note 1)
 - 7. Concrete and rock (note 2)
 - 8. Concrete masonry units (CMU), slump stone (decorative concrete blocks)
 - 9. Dirt (note 2)
 - 10. Doors
 - 11. Excavated Dirt & Rock (note 2)
 - 12. Ferrous & nonferrous metals such as banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
 - 13. Fluorescent lamps and ballasts (note 1)
 - 14. Gypsum wallboard (drywall)
 - 15. Land clearing debris & green materials (i.e. tree trimmings) (note 2)
 - 16. Paint (note 1)
 - 17. Plastic wrap, buckets, PVC
 - 18. Roofing shingles
 - 19. Used beverage containers

NOTE 1: Several common debris materials may be considered toxic, hazardous, or not easily recycled with other C&D debris. In these instances, follow appropriate disposal methods. These materials include but are not limited to:

- a. Magnetic ballasts
- b. Older fluorescent lamps containing polychlorinated biphenyls (PCBs)
- c. All fluorescent lamps that may contain mercury
- d. Treated wood
- e. Painted wood that may contain lead-based paint
- f. Unused paint

NOTE 2: Excavated materials and land clearing debris should be diverted from landfills. If the project is pursuing LEED certification this type of debris must be kept separate and cannot be counted toward LEED diversion rates.

1.04 SUMMARY

- A. The following document outlines waste management criteria for all HCA construction and demolition projects. Guidelines established in Section 01 74 19 are intended for the use of contractor and contractor's affiliates.
- B. Materials subject to the diversion requirements of this contract are the materials that are generated within the construction limits of this project, to include any materials associated with meeting the terms of this contract.

1.05 WASTE DIVERSION GOALS

- A. HCA has established that this Project shall generate the least amount of waste possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- B. Acknowledging that Construction and Demolition waste will be generated, HCA requires that the maximum quantity of waste as is economically feasible shall be minimized on the front end and diverted from the landfill. HCA will request an estimate of the project's diversion rate and an explanation for diversion rates that are not 95%.

1.06 MANAGEMENT

- A. With regard to these goals, the Contractor shall develop a Waste Management Plan (WMP) for HCA's review. Once this plan undergoes review by HCA, Contractor will be notified of project award or project denial. HCA will base project award on a number of factors included in the "best value evaluation" model. The WMP is a critical component of project award. This plan shall describe and document each of the following diversion and non-diversion activities:
 - 1. Salvage
 - 2. Reuse
 - 3. Source Separation Construction and Demolition Debris Recycling
 - 4. Co-mingled Construction and Demolition Debris Recycling
 - 5. Landfill Disposal
- B. Develop and implement a waste management plan as specified in this section. Take a proactive, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in program.
- C. The Debris Management Coordinator (DMC) shall be responsible for instructing workers and overseeing and documenting the results of the Waste Management Plan (WMP).
- D. Construction and demolition waste includes products of demolition and construction, excess of unusable C&D materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work.
- E. In the management of waste, consideration shall be given to the availability of viable markets, the condition of the materials, the ability to provide the material in suitable condition, and in a quality acceptable to available markets.

1.07 SUBMITTALS

- A. The following submittals are required to be approved by HCA:
- B. Waste Management Plan (WMP Forms A & B) to indicate how waste will be diverted from landfills.
- C. Closeout submittal including weight verification of all construction and demolition material. The percent diversion shall be documented in this submittal. This spreadsheet shall be submitted with the final closeout package submitted to HCA.

PART 2 PRODUCT

2.01 WASTE MANGEMENT PLAN (WMP):

- A. The complete Waste Management Plan (WMP) consists of two sequential documents: WMP-Form A and WMP-Form B. Contractor must complete WMP- Form A prior to commencement of debris management activities. Once awarded project, the Debris Management Coordinator (DMC) must assume debris management responsibilities including the submission of WMP- Form B and records and data to support disposal and diversion percentages.
 - 1. WMP- Form A (submit with proposal): WMP- Form A must be submitted with bid documents and is a prerequisite of project award. This document should describe planned C&D debris management activities. HCA may require Contractor to revise and resubmit the plan and does not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement.
 - 2. WMP- Form B: Once the WMP- Form A is submitted, reviewed, and approved, DMC contractor must submit WMP- Form B on a monthly basis. Form B documents actual diversion percentages. Additionally, Contractor must submit records and data that verify:
 - a. Total waste generated
 - b. Total waste diverted by recycling, reuse, or salvage
 - c. The type of waste generated/diverted
 - 3. The quantity of waste materials shall be by weight (tons). Landfill records and materials receipts shall be submitted as a formal material submittal.

2.02 WMP-FORM A - ESTIMATE OF PERCENT REDUCTION CONTRACTOR WILL ATTAIN DURING PROJECT

- A. Contractor will complete and submit the general WMP documents with the Contractor's proposal for HCA review. If approved, this WMP will serve as the basis for the monthly records and data submittals and WMP-Form B. Contractor must submit initial WMP with project proposal to avoid disqualification. This plan should include separate sections for demolition and construction projects. See Appendix A for the WMP forms and corresponding instructions for completing the form. Contractor has the option of completing the WMP forms in Appendix A or creating his own. If he creates his own, the plan must contain the following:
 - 1. Name of individuals on the Contractor's staff responsible for waste prevention and management.
 - 2. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.
 - 3. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.
 - 4. Characterization, including estimated types and quantities, of the waste to be generated.
 - 5. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.
 - 6. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by HCA.
 - 7. Description of the means by which any recyclable materials identified in item (E) above will be protected from contamination.

2.03 WMP-FORM B - ACTUAL PERCENTAGE REDUCTION CONTRACTOR ATTAINS DURING PROJECT

- A. WMP-Form B will account for all construction and demolition waste management activity from project commencement to termination. This form must be completed and submitted on a monthly basis. Failure to meet the 95% diversion requirement must be addressed with a written explanation of disparities along with WMP-Form B. Contractor has the option of completing the

WMP forms in Appendix A or creating his own. If he creates his own, the plan must contain the following:

1. Waste Characterization: Document the waste to be generated, including types and quantities by weight.
2. Diversion Options: List each material to be salvaged, reused, or recycled during the course of the Project, the proposed local market for each material, and the estimated net cost savings/ additional costs from diversion. "Net" means that the following have been subtracted from the cost of separating and recycling: (a) revenue from the sale of recycled or salvaged materials and (b) landfill tipping fees saved due to diversion of materials from the landfill.
3. Waste Reduction Calculations: Calculated end-of-project rates as a percentage of total waste.
4. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals/organizations. Indicate whether organization is tax exempt.
5. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
6. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight, tickets, receipts, and invoices.
7. LEED Submittal (If applicable): LEED letter template for Credit MR 2.1, signed by Contractor, indicating total waste material, quantities diverted and means by which it is diverted and a statement that requirements for the credit have been met.
8. Landfill Options: Include landfill contact information and costs. Provide the name of the landfill(s), respective tipping fee(s), and the total projected cost of landfill disposal.
9. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
10. Timeline: Submit a timeline of project commencement and termination in addition to a plan for periodic onsite updates of C&D debris handling.
11. Meetings: Describe the regular meetings to be held to address how to manage waste. At a minimum, discuss waste management goals and issues at pre-construction meetings and regularly scheduled job-site meetings.
12. Handling and Transportation: Describe methods of separation including the use of containers, their location, and labeling system used to identify the different materials. Describe transportation/hauling procedures, which may include but are not limited to contracting a recycling hauler, arranging transportation with the local market to be used and various means of self-transportation.
13. Negotiated approval of the Contractor WMP must be obtained prior to the commencement of waste management activities. Once notified of WMP approval, Contractor may begin WMP implementation.

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PLAN (WMP) EXECUTION

- A. Debris Management Coordinator (DMC): The Contractor shall designate an on site party (or parties) responsible for waste management instruction, oversight and documentation for the entire project.
- B. Depending on the size and complexity of the project, Contractor may either designate a full time DMC or assign responsibility to the job supervisor or appropriate personnel.
- C. Distribution: The Contractor shall distribute copies of the WMP and other pertinent information to the Job Site Foreman and to each Subcontractor.
- D. Instruction: The Contractor shall provide on-site instruction of correct separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.

- E. Source Separation: The Contractor shall identify and clearly label a specific area to facilitate separation of materials for diversion activities. Recycling and waste bin areas are to be kept neat, clean and clearly marked in order to avoid contamination of materials.
- F. If hazardous materials are found at anytime, the contractor shall halt work and inform HCA. The following is a list of appropriate source separation procedures:
 - 1. Separate recyclable materials from construction and demolition debris to the maximum extent possible. Separate recyclable materials by type.
 - 2. Provide containers, clearly labeled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
 - 3. Stockpile processed materials on-site without mixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 4. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
 - 5. Store components off the ground and protect from weather.
- G. Construction and Demolition Debris Removal:
 - 1. Buildings and their appurtenances are property of the Contractor. Revenues and savings from recycling, salvage, and reuse shall accrue to the Contractor.
 - 2. Remove construction and demolition debris from project site on a regular basis. Do not allow construction and demolition debris to accumulate on-site.
 - 3. Transport construction and demolition debris from property and dispose of it legally.
 - 4. Burning of construction and demolition debris is not permitted.

END OF SECTION

SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 3. Field changes of dimension and detail.
 4. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 1. Product data, with catalog number, size, composition, and color and texture designations.
 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 1. Description of unit or system, and component parts.
 2. Identify function, normal operating characteristics, and limiting conditions.
 3. Include performance curves, with engineering data and tests.
 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include color coded wiring diagrams as installed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

- G. Provide servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.
- L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- N. Include test and balancing reports.
- O. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Include photocopies of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION

SECTION 02 37 00

DRILLED PIERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

Extent of drilled piers is shown on drawings, including locations, diameters of shafts, diameters of bells where required, estimated bottom elevations, top elevations, and details of construction.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of American Concrete Institute (ACI) "Standard Specification for the Construction of End Bearing Drilled Piers" (ACI 336.1), and as herein specified.
- B. Where provisions of above standard conflict with building regulations in effect for this project, building regulations will govern, but only to establish minimum requirements.
- C. Drilled pier Installer Qualifications: Not less than three successfully completed contracts with similar soil conditions, shaft sizes, depths and volumes of work contained in this project. Submit satisfactory proof of compliance to Architect.
- D. Survey Work: Engage a registered surveyor to perform surveys, layouts, and measurements for drilled pier work. Conduct layout work for each drilled pier to lines and levels required before excavation, and actual measurements of each drilled pier's horizontal axial location, shaft diameter, bottom and top elevation, deviations from specified tolerances, and other data as required.
- E. Record and maintain information pertinent to each drilled pier and cooperate with other testing and inspection personnel to provide data for required reports.
- F. Owner will employ a separate testing laboratory to perform field quality control tests.
- G. Materials and installed work may require testing and retesting at any time during progress of work. Allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.
- H. Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing, when acceptable to Architect. Certificates of compliance must be signed by materials producer and Contractor.

1.3 SUBMITTALS

- A. Reports: Submit following reports directly to Architect, with copy to others as designated.

1. Certified Drilled Pier Report for each drilled pier, recording actual elevation at bottom and top, elevation of rock (if any), final centerline location at top, variation of shaft from plumb, result of tests performed, actual allowable bearing capacity of bottom, levelness of bottom, seepage of water, still water level (if allowed to flood), any unusual conditions, variation of bell dimensions (if applicable) from original design, dates of starting excavation, completion of excavation, inspection, testing, and placement of concrete (include any delays in concreting and location of construction joints in shafts).

1.4 JOB CONDITIONS

- A. Site Information: Data on indicated subsurface conditions are not intended as representation or warranties of continuity of such conditions. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor and are not guaranteed to represent conditions that may be encountered.
- B. Additional test borings and other exploratory operations may be made by Contractor at no additional cost to Owner.
- C. Existing Utilities: Locate existing underground utilities by careful hand excavation before starting drilled pier excavation operations. If utilities are to remain in place, provide protection from damage during drilled pier operations.
- D. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult Architect immediately for directions as to procedure. Cooperate with Owner, and public or private utility companies in keeping their respective service and facilities in operations. Repair damaged utilities to satisfaction of utility owner.
- E. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided.

PART 2 - PRODUCTS

2.1 CONCRETE AND RELATED MATERIALS

- A. Concrete and related materials are specified in Division 3 sections.

PART 3 - EXECUTION

3.1 DRILLED PIER EXCAVATION

- A. General: Excavate holes for drilled piers to required bearing strata or elevation as shown on drawings. Excavate holes for closely spaced drilled piers, and those occurring in fragile or sand stratas, only after adjacent holes are filled with concrete and allowed to set.
- B. Drilled Pier design dimensions shown are minimums. The design of drilled piers is based on assumed strata bearing capacity. If bearing strata is not capable of maintaining bearing capacity assumed, foundation system will be revised as directed by Architect.

Revisions will be paid for in accordance with contract conditions relative to changes in work.

- C. Construction Tolerances: Locate centerline of drilled piers within the following tolerances:
 - 1. Maximum permissible variation of location not more than 1/24th of shaft diameter or 3", whichever is less.
 - 2. Shafts out of plumb, not more than 1/5% of length nor exceeding 12.5% of shaft diameter or 15", whichever is less.
 - 3. Concrete cut-off elevation, plus 1" to minus 3".
 - 4. If above tolerances are exceeded, provide additional or corrective construction to compensate for excessive eccentricity. Submit proposed corrective construction methods to Architect for review before proceeding.
- D. Temporary Shaft Protections: When required, provide full-length watertight steel casings of sufficient thickness to withstand compressive, displacement and withdrawal stresses and to maintain shaft walls. Temporary casings may be left in place or may be withdrawn as concrete is placed, at Contractor's option.
- E. Shoring: Provide shoring in bells as required in unstable soil conditions to preclude cave-in during hand excavation and inspection operations.
- F. Classification of Rock: All excavation is unclassified.
- G. The work of this section includes demolition and removal of rock, boulders, concrete, masonry, and other subsurface obstructions which are clearly indicated by contract documents, or by available subsurface exploration data, and such work will not be considered a change in work.
- H. Dewatering: Provide and maintain pumping equipment to keep excavations free of water before placing concrete. If excessive water is encountered and drilling operations must be halted, consult with Architect before using alternate methods of construction.
- I. Conduct water to general site run-off ditches and disposal areas with discharge lines. Provide ditching as required to conduct water to site drainage facilities.
- J. Inspection: Each drilled pier must be inspected and tested before placing concrete.
- K. Provide facilities as required to assist inspection and testing of excavation, and cooperate with inspecting and testing personnel to expedite work.
- L. Notify Architect and testing facility at least 24 hours prior to time excavations will be ready for inspection and tests.
- M. Overexcavation: No payment will be made for extra length, when drilled pier shafts are excavated to a greater depth than required or authorized by Architect, due to overdrilling by Contractor. Complete drilled pier and fill extra depth with concrete, if other conditions are satisfactory. Overexcavated shafts will be measured and paid for to original design or authorized depth.

- N. Excavated Material: Deposit and spread excavated material on site at locations as directed or shown on drawings.

3.2 REINFORCING STEEL AND DOWELS

- A. Fabricate and erect reinforcing cages in shafts as one continuous unit using inner ring resteel. Place reinforcement accurately and symmetrically about axis of hole and hold securely in position during concrete placement.
- B. Use templates to set anchor bolts, leveling plates and other accessories furnished under work of other sections. Provide blocking and holding devices to maintain required position during concrete placement.
- C. Protect exposed ends of dowels and anchor bolts from mechanical damage and exposure to weather.

3.3 CONCRETE PLACEMENT

- A. General: Fill drilled pier with concrete immediately after inspection and approval by testing laboratory. Use protection sheets (cut out to receive concrete) over excavation openings, extending at least 12" beyond edge.
- B. Place concrete continuously and in a smooth flow without segregating the mixed materials. Provide mechanical vibration for consolidation of at least top 25' of each shaft.
- C. Place concrete by means of a bottom discharge bucket, flexible drop chute, elephant trunk hopper, or tremie. Use chutes or tremies for placing concrete where a drop of more than 20' is required, or pump concrete into place.
- D. Place concrete in-the-dry unless placing underwater is acceptable to Architect. If water occurs, and it is impracticable to dewater drilled pier excavation, and reasonable attempts to seal off water flow have failed, allow water level to attain its normal level and place concrete by tremie method. Control placement operations to ensure that tremie is not broken during continuous placing from bottom to top. Other methods of depositing concrete underwater may be used, if acceptable to Architect.
- E. Maintain a sufficient head of concrete to prevent reduction in diameter of drilled pier shaft by earth pressure and to prevent extraneous material from mixing with fresh concrete. Coordinate withdrawal of temporary casings with concrete placement operations to maintain a head of concrete approximately 5' above casing bottom.
- F. Stop concrete placement at cut-off elevation shown, screed level, and apply a scoured, rough finish. Where cut-off elevation is above ground elevation, form top section above grade and extend shaft to required elevation.
- F. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
 - 1. When air temperature has fallen to or is expected to fall below 40 degrees F. (4 degrees C), uniformly heat water and aggregates before mixing to obtain a concrete

mixture temperature of not less than 50 degrees F. (10 degrees C), and not more than 80 degrees F. (27 degrees C) at point of placement.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt and other mineral containing anti-freeze agents or chemical accelerators, unless otherwise accepted by Architect.
- H. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. (32 degrees C). Mixing water may be chilled, or chopped ice may be used to control concrete temperature provided water equivalent of ice is calculated to total amount of mixing water.
- I. Place concrete immediately upon delivery. Keep exposed concrete surfaces, and formed shaft extensions, moist by fog sprays, wet burlap or other effective means.
- J. Do not use retarding admixtures without acceptance of Architect.

3.4 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Sample and test concrete for quality control during placement as follows:
1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 2. Slump: ASTM C 143; one test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.
 3. Air Content: ASTM C 231, pressure method; one for each set of compressive strength test specimens.
 4. Compression Test Specimens: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
 5. Concrete Temperature: Test when air temperature is 40 degrees F (4 degrees C) and below, and when 80 degrees F (27 degrees C) and above; and each time a set of compression test specimens made.
 6. Compressive Strength Tests: ASTM C 39; one set for each 100 cu. yds. or fraction thereof, placed in one day. One specimen tested at 7 days, 2 specimens tested at 28 days, and one specimen retained in reserve for later testing if required. When strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing in-place concrete.

- B. Report test results in writing to Architect and Contractor on same day tests are made. Include in reports project identification name and number, date of concrete placement, name of Contractor, name of concrete supplier and truck number, name of concrete testing service, concrete type, location of drilled pier, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break both 7-day tests and 28-day tests.
- C. Additional Concrete Tests: Testing service may take core samples of in-place concrete when test results are such that there is reasonable doubt specified concrete strengths and other characteristics have not been attained.
- D. Complete continuous coring of drilled pier may be required, at Contractor's expense, where time for removal of temporary casings exceed specified limits, or where observations of placement operations of placement operations indicate cause for suspicion of quality of concrete, presence of voids, segregation or other possible defects.
- E. Inspection and Tests for Drilled Piers: The soil testing facility shall perform and report specified tests, and additional tests which may be required. Conduct tests and provide reports as soon as possible to not delay concreting operations for acceptable excavations.
- F. Bottom elevations and bearing capacities and lengths of drilled pier as shown on drawings are estimated from available soil data. Actual elevations, drilled pier lengths, and bearing capacities will be determined by soil testing facility from conditions found in excavations. Final evaluations and acceptance of data will be determined by Architect.

3.5 MEASUREMENT AND PAYMENT

- A. Basis for Payment: Payment for drilled piers will be made on actual net volume of drilled piers in place and accepted. The actual length and shaft diameter may vary to coincide with elevation where satisfactory bearing strata is encountered, and with actual bearing value of bearing strata determined by testing services, and with stability and characteristics of soil strata. Adjustments will be made on net variation of total quantities, based on design dimensions for shafts and bells.
- B. There will be no additional compensation for excavation, concrete fill, reinforcing, casings, or other costs due to unauthorized overexcavating shafts or bells. No payment will be made for rejected drilled piers.
- C. Prices quoted include full compensation for labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete, and other items for complete installation.
- D. Unit Prices: Unit prices for the following items, as set forth in contract conditions, will apply in event additions to or deductions from work are required and authorized by a written order from Architect to Contractor.

Unclassified excavation	per cu. yd.
Permanent steel casings, installed	per lin. ft.
Reinforcing steel and dowels, installed	per lb.
Concrete	per cu. yd.

SECTION 02 41 16
DEMOLITION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Removal and disposal of designated pavements, concrete, curbs, culverts, utilities and other structures.

1.02 RELATED WORK

- A. Section 31 11 00: Clearing and Grubbing
- B. Section 31 22 13: Site Excavation

1.03 QUALITY ASSURANCE

- A. Contractor Qualifications: Minimum of 5 years experience in demolition of comparable structures.
- B. Requirements of Regulatory Agencies:
 - 1. Comply with requirements of codes.
 - 2. Comply with requirements of local Public Health Authority.
 - 3. Comply with local utility companies and/or utility districts.

1.04 SUBMITTALS

- A. Certificates of severance of utility services.
- B. Permit for transport and disposal of debris.
- C. Demolition procedures and operational sequence for review by Owner's Representative

1.05 JOB CONDITIONS

- A. Protection:
 - 1. Erect barriers, fences, guard rails, enclosures, chutes, and shoring to protect structures, and utilities remaining intact.
 - 2. Protect designated trees and plants from damage.
- B. Maintaining Traffic:
 - 1. Ensure minimum interference with roads, street, driveways, sidewalks, and adjacent facilities.
 - 2. Do not close or obstruct streets, sidewalks, alleys or passageways without permission from authorities having jurisdiction.
 - 3. If required by governing authorities, provide alternate routes around closed or obstructed traffic ways.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 PREPARATION

- A. Prepare adjacent areas to prevent injury, movement or settlement of structures which are to remain.
- B. Arrange for, and verify termination of utility services to include removing meters and capping lines.
- C. Remove items scheduled to be salvaged for Owner, and place in designated storage area.

3.02 DEMOLITION

- A. Remove concrete pavement, base, curbs, gutters, sidewalks, driveways, etc. And dispose of as follows:
 - 1. Dispose of items which are not more than two feet below subgrade elevation.

2. Break items more than two feet below subgrade elevation into sizes not to exceed twelve inches in maximum dimension and leave in place, unless it interferes with succeeding items of construction.
 3. Stockpile ballast; gravel other pavement materials when required.
- B. Coordinate removal and relocation of power poles, traffic signal poles, street lighting, telephone lines and site lighting, with the local electric utility.
 - C. Remove existing water services, sanitary sewer and storm drainage pipe and structures as indicated and as necessary to facilitate new construction.
 - D. Remove old foundations, cisterns, etc., which may be encountered within the building area.

3.03 DEBRIS REMOVAL

- A. Promptly remove demolition debris from site.
- B. Obtain permission from applicable regulatory authority for disposal of debris to waste disposal site.
- C. Do not store or burn materials on site.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.
- B. Related Sections include the following:
 - 1. Division 2 Section "Cement Concrete Pavement" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.
- E. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

- F. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
1. Cementitious materials and aggregates.
 2. Form materials and form-release agents.
 3. Steel reinforcement and reinforcement accessories.
 4. Admixtures.
 5. Waterstops.
 6. Curing materials.
 7. Floor and slab treatments.
 8. Bonding agents.
 9. Adhesives.
 10. Vapor retarders.
 11. Epoxy joint filler.
 12. Joint-filler strips.
 13. Repair materials.
- G. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-- Reinforcing Steel."
- F. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
1. ACI 301, "Specification for Structural Concrete."
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Avoid damaging coatings on steel reinforcement.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1.
 - 2. See architectural drawing for special form finishes.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
 - 2. Furnish ties with integral water-barrier plates for concrete required to be water tight.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60 deformed.
- B. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
- B. Portland Cement: ASTM C 150, Type V.
 - 1. Fly Ash: ASTM C 618, Class C or F.
- C. Normal-Weight Aggregate: ASTM C 33, uniformly graded.
- D. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.
- D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
- E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.6 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints.
 - 1. Profile: As indicated.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. PVC Waterstops:
 - a. Greenstreak.
 - b. Meadows: W. R. Meadows, Inc.
 - c. Murphy: Paul Murphy Plastics Co.
 - d. Tamms Industries Co.; Div. of LaPorte Construction Chemicals North America, Inc.
 - e. Vinylex Corporation.
 - f. Westec Barrier Technologies; Div. of Western Textile Products, Inc.
- C. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material for adhesive bonding to concrete.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Volclay Waterstop-RX; Colloid Environmental Technologies Co.
 - b. Conseal CS-231; Concrete Sealants Inc.
 - c. Swellseal Joint; De Neef Construction Chemicals (U.S.) Inc.
 - d. Hydrotite; Greenstreak.
 - e. Mirastop; Mirafi Moisture Protection, Div. of Royal Ten Cate (USA), Inc.

2.7 VAPOR RETARDERS

- A. Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.
- B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a No. 4 sieve and 10 to 30 percent passing a No. 100 sieve; meeting deleterious substance limits of ASTM C 33 for fine aggregates.
- C. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.8 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- F. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

- G. Products: Subject to compliance with requirements, provide one of the following:
1. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound:
 - a. Spray-Cure & Seal Plus; ChemMasters.
 - b. Lumiseal Plus; L&M Construction Chemicals, Inc.
 - c. CS-309/30; W. R. Meadows, Inc.
 - d. Cure & Seal 31 percent UV; Symons Corporation.
 - e. Masterkure-N-Seal HS; ChemRex/MBT.
 2. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound:
 - a. Klear-Kote Cure-Sealer-Hardener, 30 percent solids; Burke Group, LLC (The).
 - b. Polyseal WB; ChemMasters.
 - c. Lumiseal WB Plus; L&M Construction Chemicals, Inc.
 - d. Vocomp-30; W. R. Meadows, Inc.
 - e. Masterkure-N-Seal W; ChemRex/MBT/.

2.9 RELATED MATERIALS

- A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- B. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements:
- C. Reglets: Fabricate reglets of not less than 0.0217 inch thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- D. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.10 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
 1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
 2. Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- C. Cementitious Materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.
- D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Combined Fly Ash and Pozzolan: 25 percent.
- E. Maximum Water-Cementitious Materials Ratio: 0.55 for concrete required for foundations.
- F. Maximum Water-Cementitious Materials Ratio: 0.45 for slabs on grade.
- G. Maximum Water-Cementitious Materials Ratio: 0.50 for all other concrete.
- H. Air Content Non-Exposed Concrete: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2 to 4 percent, unless otherwise indicated.
- I. Air Content Exposed Concrete: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1 percent, unless otherwise indicated:
 1. Air Content: 5.5 percent for 1-1/2-inch- nominal maximum aggregate size.
 2. Air Content: 6 percent for 3/4-inch- nominal maximum aggregate size.
- J. Do not air entrain concrete to trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.
- K. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- L. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 2. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.11 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
 - 1. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor bolts, accurately located, to elevations required.
 - 2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete provided concrete is hard enough to not

be damaged by form-removal operations and provided curing and protection operations are maintained.

- B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
 - 1. 28-day design compressive strength.
 - 2. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
 - 3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring. Engineer sealed shoring drawings shall be provided for reference.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be loaded above its allowable design load.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

- A. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions.

3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
 - 2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/4-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface. Do not wait overnight before cutting joints.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
- E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
 - 1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement.
- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
 - 2. Do not use vibrators to transport concrete inside forms.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1.
- F. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R:

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
 2. Do not apply rubbed finish to smooth-formed finish.
- C. Rubbed Finish: Apply the following to smooth-formed finished concrete:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- C. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system
 2. Finish surfaces to the tolerances noted on drawings, measured within 24 hours according to ASTM E 1155 for a randomly trafficked floor surface.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.
- C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.13 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
- B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

3.15 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of five standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.

- a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. When strength of laboratory-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- E. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.
- F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

END OF SECTION

SECTION 04 05 11
MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mortar for masonry.
- B. Grout for masonry.

1.02 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; 2011.
- B. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2010.
- C. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- E. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.
- F. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- I. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar; 2011b.
- J. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- K. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- L. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.
- M. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.
- N. ASTM C1019 - Standard Test Method for Sampling and Testing Grout; 2013.
- O. ASTM C1072 - Standard Test Method for Measurement of Masonry Flexural Bond Strength; 2013.
- P. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2008).
- Q. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2014.
- R. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2014.
- S. ASTM E518/E518M - Standard Test Methods for Flexural Bond Strength of Masonry; 2010.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
- C. Samples: Submit two samples of mortar, illustrating mortar color and color range.
- D. Reports: Submit reports on mortar indicating compliance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.
- E. Reports: Submit reports on grout indicating compliance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C1019.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.

1.05 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MORTAR AND GROUT APPLICATIONS

- A. At Contractor's option, mortar and grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.
- B. Mortar Mix Designs: ASTM C270, Property Specification.
 - 1. Masonry below grade and in contact with earth: Type S.
 - 2. Exterior Masonry Veneer: Type N.
 - 3. Exterior, Loadbearing Masonry: Type N.
 - 4. Pointing Mortar for Prefaced or Specially Faced Unit Masonry: One part Portland cement, 1/8 part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate, or ammonium stearate equal to 2 percent of Portland cement by weight.
- C. Grout Mix Designs:
 - 1. Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.

2.02 MATERIALS

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - 1. Type: Type N.
 - 2. Color: Mineral pigments added as required to produce approved color sample.
 - 3. Water repellent mortar for use with water repellent masonry units.
 - 4. Manufacturers:
 - a. Amerimix, an Oldcastle brand; AMX 410: www.amerimix.com/#sle.
- B. Portland Cement: ASTM C150/C150M.
 - 1. Type: Type I - Normal; ASTM C150/C150M.
 - 2. Color: Color as required to produce approved color sample.
 - 3. Manufacturers:
 - a. Solomon Colors; Solomon Colors Concentrated A, H, and X Series: www.solomoncolors.com/#sle.
- C. Masonry Cement: ASTM C91/C91M.
 - 1. Type: Type N; ASTM C91/C91M.
 - 2. Colored Mortar: Premixed cement as required to match Architect's color sample.
 - 3. Manufacturers:
 - a. Solomon Colors; Solomon Colors Concentrated A, H, and X Series: www.solomoncolors.com/#sle.
- D. Hydrated Lime: ASTM C207, Type S.
- E. Quicklime: ASTM C5, non-hydraulic type.
- F. Mortar Aggregate: ASTM C144.
- G. Grout Aggregate: ASTM C404.
- H. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 - 1. Color(s): As selected by Architect from manufacturer's full range.

- I. Water: Clean and potable.
- J. Accelerating Admixture: Nonchloride type for use in cold weather.
- K. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.
- L. Integral Water Repellent Admixture: Polymeric liquid admixture added to mortar at the time of manufacture.
 - 1. Performance of Mortar with Integral Water Repellent:
 - a. Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours:
 - 1) No water visible on back of wall above flashing at the end of 24 hours.
 - 2) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
 - 3) No more than 25% of wall area above flashing visibly damp at end of test.
 - b. Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
 - c. Compressive Strength: ASTM C1314; maximum 5 percent decrease.
 - d. Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
 - 2. Use only in combination with masonry units produced with integral water repellent admixture.

2.03 MORTAR MIXING

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio; mix in accordance with manufacturer's instructions, uniform in coloration.
- D. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- E. Do not use anti-freeze compounds to lower the freezing point of mortar.
- F. If water is lost by evaporation, re-temper only within two hours of mixing.

2.04 GROUT MIXING

- A. Mix grout in accordance with ASTM C94/C94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.
- C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

2.05 PRECONSTRUCTION TESTING

- A. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing.
- B. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.

3.02 GROUTING

- A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of contract documents.
- B. Low-Lift Grouting:
 - 1. Limit height of pours to 12 inches.
 - 2. Limit height of masonry to 16 inches above each pour.
 - 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.

4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- C. High-Lift Grouting:
1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
 2. Brick: Limit pours to maximum 12 feet in height and 25 feet horizontally.
 3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
 4. Place grout for spanning elements in single, continuous pour.

3.03 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 40 00 - Quality Requirements.
- B. Prism Tests: Test masonry and mortar panels for compressive strength in accordance with ASTM C1314, and for flexural bond strength in accordance with ASTM C1072 or ASTM E518/E518M; perform tests and evaluate results as specified in individual masonry sections.

END OF SECTION

SECTION 04 20 00
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Clay facing brick.
- C. Reinforcement and anchorage.
- D. Flashings.
- E. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 04 05 11 - Mortar and Masonry Grout.
- B. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2015b.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.
- E. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- F. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.
- G. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- H. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2005.
- I. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
- J. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples: Submit four samples of facing brick units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

1.05 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.

1.06 MOCK-UP

- A. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar, accessories, structural backup, wall openings, flashings (with lap joint, corner, and end dam), and wall insulation in mock-up.

- B. Locate where directed.
- C. Mock-up may not remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 BRICK UNITS

- A. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
 - 1. Color and texture: To match existing hospital campus.
 - 2. Nominal size: As indicated on drawings.
 - 3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

2.02 MORTAR AND GROUT MATERIALS

- A. Mortar and Grout: As specified in Section 04 05 11.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Mortar Aggregate: ASTM C144.
- D. Grout Aggregate: ASTM C404.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
 - 1. Blok-Lok Limited: www.blok-lok.com/#sle.
 - 2. Hohmann & Barnard, Inc; X-Seal Anchor: www.h-b.com/#sle.
 - 3. WIRE-BOND; www.wirebond.com/#sle.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi), deformed billet bars; galvanized.
- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- D. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
 - 1. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
- E. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
 - 3. Vertical adjustment: Not less than 3-1/2 inches.
 - 4. Seismic Feature: Provide lip, hook, or clip on end of wire ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 0.1483 inch diameter.

2.04 FLASHINGS

- A. Stainless Steel/Polymer Fabric Flashing: ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric.
 - 1. Manufacturers:
 - a. York Manufacturing, Inc; Multi-Flash SS: www.yorkmfg.com/#sle.

2.05 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
 - 1. Manufacturers:
 - a. Blok-Lok Limited: www.blok-lok.com/#sle.

- b. Hohmann & Barnard, Inc; _____: www.h-b.com/#sle.
 - c. WIRE-BOND; _____: www.wirebond.com/#sle.
- B. Type: Preformed aluminum vents with sloping louvers.
- C. Multicomponent Cavity Wall Drainage System: Combination mortar diverter, flashing and weep system.
 - 1. Membrane Type: Thermoplastic Polyolefin (TPO).
 - 2. Drip Edge: Stainless steel.
 - 3. Termination Bar: Polyvinyl chloride (PVC).
 - 4. System Unit Length: 5 feet, 6 inches.
 - 5. Provide pre-fabricated exterior and interior corners
 - 6. Manufacturers:
 - a. Mortar Net Solutions: www.mortarnet.com.
- D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Brick Units:
 - 1. Bond: Running.
 - 2. Coursing: Three units and three mortar joints to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Interlock intersections and external corners, except for units laid in stack bond.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

3.06 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 32 inches on center horizontally below shelf angles and lintels and near top of walls.

3.07 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 36 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- C. Seismic Reinforcement: Connect veneer anchors with continuous horizontal wire reinforcement before embedding anchors in mortar.

3.09 LINTELS

- A. Install loose steel lintels over openings.
- B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
 - 1. Openings to 42 inches: Place two, No. 3 reinforcing bars 1 inch from bottom web.
 - 2. Openings from 42 inches to 78 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
 - 3. Openings over 78 inches: Reinforce openings as detailed.
 - 4. Do not splice reinforcing bars.
 - 5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
 - 6. Place and consolidate grout fill without displacing reinforcing.
 - 7. Allow masonry lintels to attain specified strength before removing temporary supports.
- C. Maintain minimum 8 inch bearing on each side of opening.

3.10 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

3.11 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
 - 1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.12 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.13 CUTTING AND FITTING

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.14 PARGING

- A. Dampen masonry walls prior to parging.
- B. Scarify each parging coat to ensure full bond to subsequent coat.
- C. Parge masonry walls in two uniform coats of mortar to a total thickness of 3/4 inch.
- D. Steel trowel surface smooth and flat with a maximum surface variation of 1/8 inch per foot.
- E. Strike top edge of parging at 45 degrees.

3.15 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Clean soiled surfaces with cleaning solution.
- C. Use non-metallic tools in cleaning operations.

3.16 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 05 12 00
STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel.
 - 2. Architecturally exposed structural steel.
 - 3. Grout.
- B. Related Sections include the following:
 - 1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 5 Section "Steel Deck" for field installation of shear connectors.
 - 3. Division 5 Section "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.
- B. Architecturally Exposed Structural Steel: Structural steel designated as architecturally exposed structural steel in the Contract Documents.

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC's "Manual of Steel Construction, Allowable Stress Design," Part 4.
 - 2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 - 4. Indicate number and spacing of shear stud connectors.
 - 5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 6. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 7. Do not reproduce contract documents for use as shop drawings.
 - 8. Shop drawings will not be reviewed by the Designer until after the General Contractor has thoroughly reviewed the shop drawings, verified existing conditions, and coordinated the shop drawings with other affected trades. Only three sets of marked up shop drawings shall be returned by the Designer.
- C. Welding certificates.
- D. Qualification Data: For fabricator .
- E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Direct-tension indicators.
 - 4. Tension-control, high-strength bolt-nut-washer assemblies.
 - 5. Shear stud connectors.
 - 6. Nonshrink grout.
- F. Source quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CASE CSE.
- B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- D. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."

3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
5. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992.
- B. Channels, Angles: ASTM A 36.
- C. Plate and Bar: ASTM A 36.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B.
- E. Steel Pipe: ASTM A 53, Type E or S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 1. Finish: Plain.
 2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.
 - a. Finish: Plain.

- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- D. Headed Anchor Bolts: ASTM F 1554, Grade 36.
 - 1. Nuts: ASTM A 563 heavy hex carbon steel.
 - 2. Plate Washers: ASTM A 36 carbon steel.
 - 3. Washers: ASTM F 436 hardened carbon steel.
 - 4. Finish: Plain

2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. No field fabrication of structural steel allowed. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings-- Allowable Stress Design and Plastic Design."
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Drill or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning" SSPC-SP 2, "Hand Tool Cleaning" or SSPC-SP 3, "Power Tool Cleaning."

- F. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Base-Plate Holes: Drill or punch holes perpendicular to steel surfaces.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Pretensioned unless otherwise noted on drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials.
 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to one of the following specifications and standards:
1. SSPC-SP 2, "Hand Tool Cleaning."
 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Where noted on drawings, apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
1. Fill vent holes and grind smooth after galvanizing.
 2. Galvanize lintels and shelf angles located in exterior walls.

2.9 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, full pen shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design. "
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 2. Snug-tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 3. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Pretensioned unless otherwise on drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

- B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
 - 1. In addition to visual inspection, full pen field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Shear connector stud welds will be inspected and tested according to AWS D1.1 for stud welding and as follows:
 - 1. Shear connector stud welds will be visually inspected.
 - 2. Bend tests will be performed if visual inspections reveal less than a full 360-degree flash or welding repairs to any shear connector stud.
 - 3. Revise subparagraph below if an actual number or a percentage of shear connector studs requires testing.
 - 4. Tests will be conducted on additional shear connector studs if weld fracture occurs on shear connector studs already tested according to AWS D1.1.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION

SECTION 05 21 00 - STEEL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Open-web K-series steel joists.
 - 2. Joist accessories.
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete" for installing bearing plates in concrete.
 - 2. Division 4 Section "Unit Masonry Assemblies" for installing bearing plates in unit masonry.

1.3 DEFINITIONS

- A. Special Joists: Joists requiring modification by the manufacturer to support nonuniform, unequal, or special loading conditions that invalidate SJ's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders."

1.4 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product indicated.
- B. Shop Drawings: Show layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.
 - 1. Indicate locations and details of anchorage devices and bearing plates to be embedded in other construction.
 - 2. Certification signed and sealed by the professional engineer registered in the state where the project is to be constructed who is responsible for its preparation that the joists and joist girders are designed per requirements of the contract documents.
 - 3. Shop drawings will not be reviewed by the Designer until after the structural steel subcontractor and General Contractor have thoroughly reviewed the shop drawings, verified existing conditions, and coordinated the shop drawings with other affected trades. Only three sets of marked-up shop drawings shall be returned by the Designer.

- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Mill certificates signed by manufacturers of bolts certifying that their products comply with specified requirements.
- E. Research/Evaluation Reports: Evidence of steel joists' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.
- B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.3 "Structural Welding Code--Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.7 SEQUENCING

- A. Deliver steel bearing plates and other devices to be built into concrete and masonry construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for chord and web members.
- B. Steel Bearing Plates: ASTM A 36/A 36M.
- C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
- D. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
- E. Welding Electrodes: Comply with AWS standards.

2.2 PRIMERS

- A. Primer: SSPC-Paint 15, Type I, red oxide; FS TT-P-636, red oxide; or manufacturer's standard shop primer complying with performance requirements of either of these red-oxide primers.
- B. Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements in FS TT-P-664.

2.3 OPEN-WEB K-SERIES STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord; of joist type indicated.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
- E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- F. Camber joists according to SJI's "Specifications."
- G. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.
- B. Fabricate steel bearing plates with integral anchorages of sizes and thicknesses indicated. Shop prime paint.
- C. Where indicated on architectural drawings, supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface, unless otherwise indicated.
- D. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories to be primed by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply one shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead load have been applied unless otherwise noted on drawings.
- C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.
- E. Comply with all OSHA requirements for joist erection.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

- B. Field welds will be visually inspected according to AWS D1.1.
- C. Bolted connections will be visually inspected.
- D. Correct deficiencies in Work that inspections and test reports have indicated are not in compliance with specified requirements.
- E. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates and abutting structural steel.
 - 1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
 - 2. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formed steel stud exterior wall framing.
- B. Exterior wall sheathing.
- C. Formed steel joist and purlin framing and bridging.
- D. Water-resistive barrier over sheathing.

1.02 REFERENCE STANDARDS

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- E. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2011c.
- F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2011a.
- G. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- I. PS 1 - Structural Plywood; 2009.
- J. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
- C. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
 - 1. Indicate stud layout.
 - 2. Describe method for securing studs to tracks and for bolted framing connections.
 - 3. Design data:
 - a. Shop drawings signed and sealed by a professional structural engineer.
- D. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention.

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Missouri.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.

1.05 MOCK-UP

- A. Provide mock-up of exterior framed wall, including components specified elsewhere, such as insulation, sheathing, window frame, door frame, exterior wall finish, and interior wall finish.
- B. Mock-Up Size: 10 by 10 feet, including corner condition.
- C. Location: As directed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing:
 - 1. CEMCO: www.cemcosteel.com/#sle.
 - 2. ClarkDietrich Building Systems: www.clarkdietrich.com/#sle.
 - 3. Marino: www.marinoware.com/#sle.
 - 4. SCAFCO Corporation: www.scafco.com/#sle.
 - 5. The Steel Network, Inc: www.SteelNetwork.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Framing Connectors and Accessories:
 - 1. Same manufacturer as metal framing.
 - 2. Simpson Strong Tie: www.strongtie.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
- B. Design Requirements: Provide completed framing system having the following characteristics:
 - 1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100-12.
 - 2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
 - 3. Design Loads: In accordance with applicable codes.
 - 4. Live load deflection meeting the following, unless otherwise indicated:
 - a. Floors: Maximum vertical deflection under live load of 1/480 of span.
 - b. Roofs: Maximum vertical deflection under live load of 1/240 of span.
 - c. Exterior Walls: Maximum horizontal deflection under wind load of 1/240 of span.
 - d. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.
 - 5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
 - 6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 FRAMING MATERIALS

- A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
 - 1. Gage and Depth: As required to meet specified performance levels.
 - 2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
 - 3. Provide components fabricated from ASTM A1008/A1008M, Designation SS (structural steel).
- B. Framing Connectors: Factory-made, formed steel sheet.
 - 1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch, and factory punched holes and slots.

2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
 - a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
 - b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
 - c. Provide top track with long leg track and head of wall movement connectors; minimum track length of 10 feet.
4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
5. Wall Stud Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connections where indicated on the drawings.

2.04 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
- B. Anchorage Devices: Powder actuated.
- C. Welding: Comply with AWS D1.1/D1.1M.

2.05 WALL SHEATHING

- A. Plywood; PS 1, Grade C-C, Exterior Exposure. (backside of parapets)
- B. Wall Sheathing: Glass mat faced gypsum; ASTM C1177/C1177M, square long edges, 1/2 inch.

2.06 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- C. Water-Resistive Barrier: As specified in Section 07 25 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that building framing components are ready to receive work.

3.02 INSTALLATION OF STUDS

- A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
- B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.
- C. Place studs at 16 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.
- D. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- E. Install load bearing studs, brace, and reinforce to develop full strength and achieve design requirements.
- F. Install intermediate studs above and below openings to align with wall stud spacing.

- G. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
- H. Attach cross studs to studs for attachment of fixtures anchored to walls.
- I. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- J. Touch-up field welds and damaged galvanized surfaces with primer.

3.03 INSTALLATION OF JOISTS AND PURLINS

- A. Install framing components in accordance with manufacturer's instructions.
- B. Make provisions for erection stresses. Provide temporary alignment and bracing.
- C. Place joists at 12 inches on center; not more than 2 inches from abutting walls, and connect joists to supports using fastener method.
- D. Locate joist end bearing directly over load bearing studs or provide load distributing member to top of stud track.
- E. Provide web stiffeners at reaction points.
- F. Touch-up field welds and damaged primed surfaces with primer.

3.04 INSTALLATION OF WALL SHEATHING

- A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
 - 1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.
- B. Prefabricated ladders and ship ladders.

1.02 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- E. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- I. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2011.
- J. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- K. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

- A. Ladders: Aluminum; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
 - 1. Side Rails: 3/8 x 2 inches members spaced at 20 inches.
 - 2. Rungs: one inch diameter solid round bar spaced 12 inches on center.
 - 3. Space rungs 7 inches from wall surface.
- B. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- C. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
- D. Lintels: As detailed; prime paint finish.
- E. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.
- F. Toilet Partition Suspension Members: Steel channel sections; prime paint finish.

2.05 PREFABRICATED LADDERS

- A. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
 - 1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
 - 2. Materials: Aluminum; ASTM B221 (ASTM B221M), 6063 alloy, T52 temper.
 - 3. Finish: Mill finish aluminum.
 - 4. Manufacturers:
 - a. O'Keeffe's Inc; Model 501: www.okeeffes.com/#sle.

2.06 FINISHES - STEEL

- A. Prime paint steel items.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.

2.07 FINISHES - ALUMINUM

- A. Interior Aluminum Surfaces: Class I natural anodized.
- B. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.08 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.

- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.02 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on shop drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 05 51 00
METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stairs with concrete treads.
- B. Structural steel stair framing and supports.
- C. Handrails and guards.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal anchors in concrete.

1.03 REFERENCE STANDARDS

- A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- I. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- L. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Include the design engineer's seal and signature on each sheet of shop drawings.
- C. Design Data: As required by authorities having jurisdiction.
- D. Welders' Certificates.
- E. Designer's Qualification Statement.
- F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

1.05 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in Missouri, or personnel under direct supervision of such an engineer.
- B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
- C. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
 - 2. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.01 METAL STAIRS - GENERAL

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
 - 1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
 - 2. Handrails: Comply with applicable accessibility requirements of ADA Standards.
 - 3. Structural Design: Provide complete stair and railing assemblies complying with the applicable local code.
 - 4. Photoluminescent Stair Accessories: Comply with applicable building code.
 - 5. Dimensions: As indicated on drawings.
 - 6. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
 - 7. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
 - 8. Separate dissimilar metals using paint or permanent tape.
- B. Metal Jointing and Finish Quality Levels:
 - 1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
 - c. Exposed Edges and Corners: Eased to small uniform radius.
 - d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 METAL STAIRS WITH CONCRETE TREADS

- A. Jointing and Finish Quality Level: Architectural, as defined above.
- B. Risers: Closed.
- C. Treads: Metal pan with field-installed concrete fill.
 - 1. Concrete Depth: 1-1/2 inches, minimum.
 - 2. Tread Pan Material: Steel sheet.
 - 3. Tread Pan Thickness: As required by design; 14 gage, 0.075 inch minimum.
 - 4. Pan Anchorage to Stringers: Continuously welded, from top or bottom.
 - 5. Concrete Reinforcement: None.
 - 6. Concrete Finish: For resilient floor covering.
- D. Risers: Same material and thickness as tread pans.
 - 1. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.

2. Nosing Depth: Not more than 1-1/2 inch overhang.
3. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.
- E. Stringers: Rolled steel channels.
 1. Stringer Depth: 10 inches.
 2. End Closure: Sheet steel of same thickness as risers welded across ends.
- F. Landings: Similar construction, using corrugated steel decking, supported and reinforced as required to achieve design load capacity.
- G. Railings: Steel picket railings.
- H. Finish: Shop- or factory-prime painted.
- I. Under Side of Stair: Exposed to view, to be finished same as specified for other exposed to view surfaces.

2.03 HANDRAILS AND GUARDS

- A. Wall-Mounted Rails: Round pipe or tube rails unless otherwise indicated.
 1. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.
- B. Guards:
 1. Top Rails: Round pipe or tube rails unless otherwise indicated.
 - a. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.
 2. Infill at Picket Railings: Vertical pickets.
 - a. Horizontal Spacing: Maximum 4 inches on center.
 - b. Material: Solid steel bar.
 - c. Shape: Square.
 - d. Size: 1/4 inch square.
 - e. Top Mounting: Welded to underside of top rail.
 - f. Bottom Mounting: Welded to top surface of stringer.
 3. End and Intermediate Posts: Same material and size as top rails.
 - a. Horizontal Spacing: As indicated on drawings.
 - b. Mounting: Welded to top surface of stringer.

2.04 MATERIALS

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- C. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
 1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
 2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
- E. Concrete Fill: Portland cement Type I, 3000 psi 28 day strength, 2 to 3 inch slump.
- F. Concrete Reinforcement: Mesh type as detailed, galvanized.

2.05 ACCESSORIES

- A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
- B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.06 SHOP FINISHING

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.

- C. Prime Painting: Use specified shop- and touch-up primer.
 - 1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
 - 2. Number of Coats: One.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. When field welding is required, clean and strip primed steel items to bare metal.
- B. Supply items required to be cast into concrete with setting templates.

3.03 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof-mounted curbs.
- B. Roofing nailers.
- C. Roofing cant strips.
- D. Preservative treated wood materials.
- E. Fire retardant treated wood materials.
- F. Communications and electrical room mounting boards.
- G. Concealed wood blocking, nailers, and supports.

1.02 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- C. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- F. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.
- G. ICC-ES AC308 - Acceptance Criteria for Termite Physical Barrier Systems; 2014, with Editorial Revision (2017).
- H. PS 1 - Structural Plywood; 2009.
- I. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.
- J. PS 20 - American Softwood Lumber Standard; 2010.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials and application instructions.
- C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.

2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 1. Lumber: S4S, No. 2 or Standard Grade.
 2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

- A. Wall Sheathing, For back and top of parapets: Any PS 2 type.
 1. Bond Classification: Exterior.
 2. Grade: Sheathing.
 3. Span Rating: 24.
 4. Performance Category: 5/16 PERF CAT.
 5. Edge Profile: Square edge.
- B. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 1/2 inch.
 1. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 2. Edges: Square.
- C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 ACCESSORIES

- A. Fasteners and Anchors:
 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 3. Anchors: Toggle bolt type for anchorage to hollow masonry.
- B. Termite-Resistant Sill Plate Barrier: Self-adhesive, film-backed barrier with release sheet; adheres to concrete substrates and blocks termite access.
 1. Thickness: 68 mils (0.068 inch).
 2. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
 3. Manufacturers:
 - a. Polyguard Barrier Systems, Inc, a division of Polyguard Products, Inc; TERM Sill Plate Barrier: www.polyguardbarriers.com/#sle.
- C. Termite-Resistant Sill Flashing: Self-adhesive membrane; polyethylene film bonded to sealant.
 1. Thickness: 40 mils (0.040 inch).
 2. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
 3. Water Vapor Permeance: 0.035 perm, maximum, when tested in accordance with ASTM E96/E96M.
 4. Manufacturers:
 - a. Polyguard Barrier Systems, Inc, a division of Polyguard Products, Inc; TERM Flashing Barrier: www.polyguardbarriers.com/#sle.

2.05 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
1. Manufacturers:
 - a. Lonza Group: www.wolmanizedwood.com/#sle.
 - b. Hoover Treated Wood Products, Inc: www.frtw.com/#sle.
 - c. Koppers, Inc: www.koppersperformancechemicals.com/#sle.
 - d. Viance, LLC; D-Blaze: www.treatedwood.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Interior Type A: AWWA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat rough carpentry items as indicated .
 - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
- C. Preservative Treatment:
1. Manufacturers:
 - a. Lonza Group: www.wolmanizedwood.com/#sle.
 - b. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com/#sle.
 - c. Viance, LLC; Preserve ACQ: www.treatedwood.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Preservative Pressure Treatment of Lumber Above Grade: AWWA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - b. Treat lumber exposed to weather.
 - c. Treat lumber in contact with roofing, flashing, or waterproofing.
 - d. Treat lumber in contact with masonry or concrete.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- F. Provide the following specific non-structural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall-mounted door stops.
 - 7. Chalkboards and marker boards.
 - 8. Wall paneling and trim.
 - 9. Joints of rigid wall coverings that occur between studs.

3.04 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
 - 1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.
 - 4. Cover all walls, starting 6" above floor to 8'-6" AFF

3.06 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.07 CLEANING

- A. Waste Disposal: Comply with the requirements of Section 01 74 19 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 16 43
GYPSUM SHEATHING (DENSGLOSS)

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Glass-mat gypsum wall sheathing.
 - 2. Sealing joints and penetrations in and associated with gypsum sheathing.

1.02 RELATED REQUIREMENTS:

- A. Section 06 16 36 "Plywood Sheathing" for backside of parapets.
- B. Section 07 27 26 "Fluid-Applied Membrane Air Barrier" for air barrier applied over wall sheathing.

1.03 DEFINITIONS

- A. Gypsum Board Construction Terminology Standard: Refer to ASTM C 11 for definitions of terms for gypsum sheathing board construction not defined in this Section or in other referenced standards.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Comply with provisions of Division 05 Section "Structural Metal Stud Framing." On Shop Drawings required by that Section, indicate exterior sheathing screw fastener spacing to be utilized at field, perimeter, and corners to comply with design wind loads.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store materials protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, or other causes. Stack sheathing flat on leveled supports off the ground, under cover, and fully protected from weather.

1.06 COORDINATION

- A. Glass-Mat Gypsum Sheathing Board:
 - 1. Do not leave exposed to weather for more than 180 days unless otherwise approved in writing by manufacturer.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or GA-600, "Fire Resistance Design Manual".

2.02 GYPSUM SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/C 1177M with acrylic coating on exterior side.
- B. Manufacturers: Subject to compliance with requirements, provide products by manufacturers listed in Document 002150 - Owner's Preferred Vendor List. No substitutions permitted.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. United States Gypsum Co.; Securock.
 - To be purchased from:
 - Deb Sottile
 - L&W Supply, National Accounts Manager
 - DSottile@LWSupply.com
 - Phone: 773-704-7157
 - 2. Type and Thickness: Regular, 1/2 inch (13 mm) thick.

3. Permeance: Not less than 26 perms per ASTM E 96.
4. Size: 48 inches by 120 inches (1219 mm by 3048 mm).
5. Mold Growth: 10, per ASTM D 3273.

2.03 FASTENERS

- A. Fasteners: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
 1. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, attach sheathing with drill screws complying with ASTM C 954.

2.04 SHEATHING JOINT AND PENETRATION SEALANT

- A. Sheathing Sealant: Refer to Section 07 27 26 "Fluid-Applied Membrane Air Barrier". Sealant must be approved by Air-Barrier manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.02 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and manufacturer's written instructions.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
 1. Install boards with a 3/8-inch (9-mm) gap where non-load-bearing construction abuts structural elements.
 2. Install boards with a 1/4-inch (6.4-mm) gap where they abut concrete, masonry, or similar materials that might retain moisture, to prevent wicking.
- C. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.
- D. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.
- E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.
- F. Horizontal Installation: Install sheathing with ends of boards over centers of stud flanges, and stagger end joints of adjacent boards not less than one stud spacing. Screw-attach boards at perimeter and within field of board to each steel stud.
 1. Space fasteners approximately 8 inches (200 mm) on center and set back a minimum of 3/8 inch (9 mm) from edges and ends of boards.
 - a. Decrease spacing between fasteners where required to comply with design wind loads, and as indicated in shop drawings submitted under Division 05 Section "Cold-Formed Metal Framing."
 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- G. Vertical Installation: Install board with vertical edges centered over flanges of steel studs. Abut ends and edges of each board with those of adjacent boards. Screw-attach boards at perimeter and within field of board to each steel stud.

1. Space fasteners approximately 8 inches (200 mm) on center and set back a minimum of 3/8 inch (9 mm) from edges and ends of boards.
 - a. Decrease spacing between fasteners where required to comply with design wind loads, and as indicated in shop drawings submitted under Division 05 Section "Cold-Formed Metal Framing."
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

3.03 SHEATHING JOINT-AND-PENETRATION TREATMENT

- A. Seal sheathing joints according to "Air-Barrier" manufacturer's written recommendations.
 1. Apply sealant on joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling, unless directed otherwise by "Air-Barrier" manufacturer's written instructions. Seal other penetrations and openings.
 - a. Utilize primers and tapes as recommended by sealant manufacturer at corners and joints at adjacent substrates.
- B. Taping of joints will not be accepted as an alternative or substitute for application of joint sealant.

END OF SECTION

SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Cabinet hardware.

1.02 RELATED REQUIREMENTS

- A. Section 12 36 00 - Countertops.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWI (QCP) - Quality Certification Program; current edition at www.awiqcp.org.
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- D. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- F. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- C. Product Data: Provide data for hardware accessories.
- D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
 - 2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 - 6. Replace, repair, or rework all work for which certification is refused.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.07 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Cabinets:
 - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 - 2. Finish - Exposed Interior Surfaces: Decorative laminate.
 - 3. Finish - Semi-Exposed Surfaces: Decorative laminate
 - 4. Finish - Concealed Surfaces: Manufacturer's option.
 - 5. Door and Drawer Front Edge Profiles: Radius edge with thick applied band.
 - 6. Door and Drawer Front Retention Profiles: Fixed panel.
 - 7. Casework Construction Type: Type A - Frameless.
 - 8. Interface Style for Cabinet and Door: Style 2 - Finish Inset; reveal overlay.
 - 9. Patterned Face Layout for Cabinet and Door Fronts: Flush panel.
 - a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
 - 10. Cabinet Design Series: As indicated on drawings.
 - 11. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - a. Deflection: L/144.
 - 12. Cabinet Style: Flush overlay.
 - 13. Cabinet Doors and Drawer Fronts: Flush style.
 - 14. Drawer Side Construction: Multiple-dovetailed.
 - 15. Drawer Construction Technique: Dovetail joints.

2.02 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.03 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation: www.formica.com/#sle.
 - 2. Panolam Industries International, Inc; Nevamar: www.nevamar.com/#sle.
 - 3. Wilsonart LLC: www.wilsonart.com/#sle.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as follows:
 - 1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, color as selected, finish as selected.
 - 2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, color as selected, finish as selected.
 - 3. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.04 COUNTERTOPS

- A. Countertops are specified in Section 12 36 00.

2.05 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.

- B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
 - 1. Color: As selected by Architect from manufacturer's standard range.
 - 2. Use at all exposed plywood edges.
 - 3. Use at all exposed shelf edges.
- C. Fasteners: Size and type to suit application.
- D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- E. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.

2.06 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
- C. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.
- D. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
- E. Catches: Magnetic.
- F. Drawer Slides:
 - 1. Type: Full extension.
 - 2. Static Load Capacity: Heavy Duty grade.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Features: Provide self closing/stay closed type.
- G. Hinges: European style concealed self-closing type, steel with polished finish.
- H. Soft Close Adapter: Concealed, frame-mounted, screw-adjustable damper ; steel with polished finish.

2.07 SHOP TREATMENT OF WOOD MATERIALS

- A. Provide UL (DIR) listed and approved identification on fire retardant treated material.
- B. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

2.08 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
- E. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
 - 1. Provide center matched panels at each elevation.
 - 2. Provide sequence matching across each elevation.
 - 3. Carry figure of cabinet fronts to toe kicks.
- F. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.

- G. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- F. Secure cabinets to floor using appropriate angles and anchorages.
- G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

- A. Test installed work for rigidity and ability to support loads.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 12 00
BUILT-UP BITUMINOUS WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hot applied asphaltic waterproofing.
- B. Cold applied asphaltic waterproofing.
- C. Cant strips.
- D. Drainage panels.
- E. Protective cover.

1.02 REFERENCE STANDARDS

- A. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011.
- B. ASTM D449/D449M - Standard Specification for Asphalt Used in Dampproofing and Waterproofing; 2003 (Reapproved 2014).
- C. ASTM D1668/D1668M - Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing; 1997a (Reapproved 2014).
- D. ASTM D3747 - Standard Specification for Emulsified Asphalt Adhesive for Adhering Roof Insulation; 1979 (Reapproved 2007).
- E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide properties of primer, bitumen, mastics, and characteristics of reinforcement fabric.
- C. Shop Drawings: Indicate flashings, control joints and expansion joints, sealing at openings, projections, penetrations, and reglets, and waterproofing of holes, slots, and sleeves.
- D. Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty against failure of waterproofing to resist penetration of water, except where such failures are the result of structural failures of building.
 - 1. Hairline cracking of concrete due to temperature change or concrete shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.01 WATERPROOFING APPLICATIONS

- A. Elevator Pit Walls: Three plies of hot asphaltic waterproofing, glass fiber reinforcing fabric.

2.02 HOT ASPHALTIC MATERIALS

- A. Asphalt: ASTM D449/D449M, Type I.

- B. Asphalt Primer: ASTM D41/D41M, compatible with substrate.
- C. Sealing Mastic: Asphalt roof cement, ASTM D4586/D4586M, Type I, asbestos free.
- D. Reinforcing Fabric: Glass fiber, ASTM D1668/D1668M, Type I, woven, asphalt treated.

2.03 COLD ASPHALTIC MATERIALS

- A. Asphalt Emulsion: Complying with ASTM D3747.
- B. Reinforcing Fabric: Glass fiber, ASTM D1668/D1668M, Type I, woven, asphalt treated.

2.04 ACCESSORIES

- A. Protection Board: 1/8 inch thick biodegradable hardboard; with integral drainage channels.
- B. Drainage Panel: 1/4 inch thick formed plastic, and embossed with cover sheet.
- C. Cant Strips: Premolded composition material.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify substrate surfaces are durable and free of matter detrimental to adhesion or application of waterproofing system.

3.02 PREPARATION

- A. Protect adjacent surfaces not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
- C. Do not apply waterproofing to surfaces unacceptable to manufacturer.
- D. Apply mastic to seal penetrations, small cracks, or minor honeycomb in substrate.

3.03 WATERPROOFING INSTALLATION

- A. Install cant strips at inside corners.
- B. Apply moppings of bitumen and embed reinforcement in accordance with manufacturer's instructions.
- C. Apply hot bitumen at a temperature limited by equiviscous temperature (EVT) plus or minus 25 degrees F; do not exceed finish blowing temperature for four hours.
- D. Roll or press reinforcing fabric firmly into bitumen eliminating wrinkles, air pockets, or disruptions of continuity. Lap edges and ends 6 inches. Weather lap sheet materials.
- E. Apply two plies of reinforcing fabric diagonal to inside corner interruptions to membrane.
- F. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches above horizontal surface for first ply and 6 inches at subsequent plies laid in shingle fashion.
- G. Terminate top edge of membrane and flexible flashing under counter flashings, seal with mastic. Coordinate with metal flashing installation.
- H. Seal protrusions to and penetrations through membrane with multiple plies of reinforcement. Seal watertight.

3.04 PROTECTION BOARD AND DRAINAGE PANEL INSTALLATION

- A. Place drainage panel directly against membrane; butt joints; position to direct drainage downward.
- B. Place protection board directly against drainage panel; butt joints.
- C. Adhere protection board and drainage panel to substrate with mastic, and scribe and cut boards around projections, penetrations, and interruptions.

3.05 PROTECTION

- A. Protect membrane and board from damage.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation and integral vapor retarder at cavity wall construction, perimeter foundation wall, underside of floor slabs, and over roof deck.

1.02 RELATED REQUIREMENTS

- A. Section 07 54 00 - Thermoplastic Membrane Roofing: Insulation specified as part of roofing system.

1.03 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015a.
- B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- B. Insulation Inside Masonry Cavity Walls: Extruded polystyrene (XPS) carbon black board.
- C. Insulation Over Roof Deck: Extruded polystyrene (XPS) board.

2.02 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
 - 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.
 - 5. Board Edges: Square.
- B. Extruded Polystyrene (XPS) Cavity Wall Insulation Board: Complies with ASTM C578, and manufactured using carbon black technology.
 - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
 - 4. Board Size: 15-3/4 inch by 96 inch.
 - 5. Board Thickness: 1-3/4 inch.
 - 6. Board Edges: Square.
- C. Polyisocyanurate (ISO) Board Insulation with Facers Both Sides: Rigid cellular foam, complying with ASTM C1289.

1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
3. Board Edges: Square.

2.03 ACCESSORIES

- A. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.
- B. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- C. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Adhere a 6 inch wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
 1. Tape seal joints.
 2. Extend sheet full height of joint.
- B. Apply adhesive to back of boards:
 1. Three continuous beads per board length.
 2. Full bed 1/8 inch thick.
- C. Install boards horizontally on foundation perimeter.
 1. Place boards to maximize adhesive contact.
 2. Install in running bond pattern.
 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- D. Extend boards over expansion joints, unbonded to foundation on one side of joint.
- E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.02 BOARD INSTALLATION AT CAVITY WALLS

- A. Adhere a 6 inch wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
 1. Tape seal joints between sheets.
 2. Extend sheet full height of joint.
- B. Apply adhesive to back of boards:
 1. Three continuous beads per board length.
 2. Full bed 1/8 inch thick.
- C. Install boards to fit snugly between wall ties.
 1. Place membrane surface against adhesive.
 2. Place membrane surface facing out, and tape seal board joints.
- D. Install boards horizontally on walls.
 1. Place boards to maximize adhesive contact.
 2. Install in running bond pattern.
 3. Butt edges and ends tightly to adjacent boards and to protrusions.
 4. Place impale fastener locking discs.
- E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- F. Place 6 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames, and tape seal in place to ensure continuity of vapor retarder and air seal.

3.03 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.04 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

- A. Board Installation Over Roof Deck, General:
 - 1. See applicable roofing specification section for specific board installation requirements.
 - 2. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
 - 3. Do not apply more insulation than can be covered with roofing in same day.

3.05 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 21 16
THERMAL BATT INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Section 072610: Vapor retarder materials adjacent to insulation.
- B. Section 092900: Batt-type sound insulation.

1.02 REFERENCED STANDARDS

- A. American Society for Testing and Materials (ASTM).
 - 1. E84-Test Method for Surface Burning Characteristics of Building Materials.
 - 2. E136-Test Method for Behavior of Materials in a Vertical Tube Furnace at 750oC.
 - 3. C518-Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter.
 - 4. C665-Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

1.03 SUBMITTALS

- A. Submit items under provisions of Section 013310.
- B. Submit product data showing product characteristics, performance criteria, limitations and installation instructions. Include certification that insulation is free of formaldehyde.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver items to the site and handle, store and protect under provisions of Section 016000.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Acceptable manufacturers: Refer to the Owner's Bulk Purchasing Vendor List in Document 002150 for the Owner's preferred manufacturer. Materials of manufacturers other than the preferred manufacturers which are of the same function and performance will be considered under provisions of Section 016000.
- B. Insulation: Full-thick non-backed formaldehyde-free fiberglass batts, thickness as indicated, complying with the property requirements of ASTM C665, Type 1, and ASTM E136. Use insulation wide enough to compress between building components and completely fill the cavity being insulated.
 - 1. Maximum flame characteristics: Flame Spread rating of 10, Smoke Development rating of 10 when tested in accordance with ASTM E84.
 - 2. Minimum thermal insulating value: R-value of 3 per inch thickness when tested in accordance with ASTM C518.
 - 3. Dimensional stability: Linear shrinkage less than 0.1%.
- C. Tie wire: 22 gauge galvanized steel wire.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Preparation:
 - 1. Verify adjacent materials are dry and ready to receive insulation.
 - 2. Verify mechanical and electrical services within walls have been installed and tested.
 - 3. Coordinate the work of this Section with the work of Section 072610 for installation of vapor retarder materials.
- B. Install insulation in accordance with the manufacturer's printed instructions without voids or gaps. Use batts free of damage. Do not compress insulation.
- C. Trim insulation to neatly fit spaces. Insulate miscellaneous gaps.

- D. Fit insulation tight in spaces and tight to exterior side of mechanical, plumbing and electrical services within the plane of the insulation.

3.02 PROTECTION

- A. Protect installed insulation from weather damage.
- B. Replace insulation that becomes wet or is otherwise damaged with new insulation.

END OF SECTION

SECTION 07 24 19
WATER DRAINAGE EIFS SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Water-drainage exterior insulation and finish system (EIFS) with decorative foam shapes, including liquid-applied air/moisture applied over gypsum sheathing.
- B. Related Sections include the following:
 - 1. Division 04 Section "Unit Masonry" for concrete masonry unit substrate.
 - 2. Division 06 Section "Gypsum Sheathing" for sheathing.
 - 3. Division 07 Section "Joint Sealants" for requirements of joints sealants used in EIFS.

1.02 SYSTEM DESCRIPTION

- A. Water-Drainage Class PB EIFS: A non-load-bearing, exterior wall cladding system that consists of an insulation board attached adhesively to the substrate over a liquid applied air/moisture barrier in a manner allowing water entering into the system to drain to the exterior; an integrally reinforced base coat; and a textured protective finish coat as indicated on Drawing.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type and component of EIFS indicated.
- B. Shop Drawings: For EIFS. Include plans, elevations, sections, details of components, details of penetration and termination, flashing details, joint locations and configurations, fastening and anchorage details, and connections and attachments to other work.
- C. Samples for initial Selection: Submit manufacturer's color chart showing complete line of available colors and textures for selection by Architect.
 - 1. Coordinate submittal of color chart with submittal of joint sealant color samples specified in Division 07 Section "Joint Sealants."
 - 2. Architect will select colors for these items concurrently, for subsequent incorporation of these items into mock-up panel, and to facilitate desired color scheme for entire building.
- D. Samples for Verification: 24-inch-(600-mm-) square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work including custom trim, each profile, an aesthetic reveal, a typical control joint filled with sealant of color selected.
 - 1. Include sealants samples to verify color selected.

1.04 INFORMATIONAL SUBMITTALS

- A. Installer Certificates:
 - 1. Signed by system manufacturer certifying that installers comply with specified requirements.
 - 2. Submit proof of payment and performance bonding for this specific project.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and address of architects and owners, and other information specified.
- C. Manufacturer Certificates: Signed by manufacturers certifying that EIFS and joint sealants comply with requirements.
- D. Material or Product Certificates: For base coat water resistant coating, adhesive, insulation, finish coat and joint sealant, from manufacturer.
- E. Field quality-control reports and special inspection reports.
- F. Sample Warranty: Submit unexecuted copy of EIFS manufacturer's warranty stating obligations, remedies, limitations, and exclusions of warranty.
- G. Project Observation Form:

1. Submit two copies to Architect and Owner's representative within 48 hours of each site visit.
2. Use form included at the end of this Section.
3. Refer to Field Quality Control article in Part 3.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For EIFS to include in maintenance manuals.
- B. Warranties: Special warranty specified in this Section.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who is certified in writing by EIFS manufacturer as qualified to install manufacturer's system using trained workers.
 1. Bondable. Refer to "Informational Submittals" Article above.
- B. Source Limitations: Obtain EIFS from single source from single EIFS manufacturer and from sources approved by EIFS manufacturer as compatible with system components.
- C. Fire-Test-Response Characteristics: Provide EIFS and system components with the following fire-test-response characteristics as determined by testing identical EIFS and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
 1. Radiant Heat Exposure: No ignition of EIFS when tested according to NFPA 268.
 2. Surface-Burning Characteristics: Provide insulation board, adhesives, base coats, and finish coats with flame-spread index of 25 or less and smoke-developed index of 450 or less, per ASTM E 84.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Construct sample panel at jobsite, in location directed by Architect.
 2. Size: Minimum 4 feet wide by 8 feet tall 2 feet deep sample wall with one outside corner. Wall construction shall include the following:
 - a. Typical wall substrate including studs, sheathing, and primer/sealer.
 - b. Outside corner construction.
 - c. Scheduled insulation thickness.
 - d. Weep screed/starter track.
 - e. Typical routed joint (reveal), horizontal and vertical.
 - f. Typical sealant joint, including sealant in selected color.
 - g. Typical window opening construction, including flashings.
 - h. Typical parapet/cornice construction.
 - i. Approved color, texture, and finish.
 3. Utilize sample panel for coordination with trades whose work is adjacent to or interfaces with EIFS.
 4. Approval of sample panels is for color, texture, sealant colors to EIFS colors, tooling of joints, aesthetic qualities of workmanship, and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
 1. Include each trade whose work is adjacent to or interfaces with EIFS.
 2. Include system manufacturer's representative.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.

- B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.
 - 1. Stack insulation board flat and off the ground.
 - 2. Protect plastic insulation against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.08 PROJECT CONDITIONS

- A. Weather Limitations: Maintain ambient temperatures above 40 deg F (4.4 deg C) for a minimum of 24 hours before, during, and after adhesives or coatings are applied. Do not apply EIFS adhesives or coatings during rainfall. Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit EIFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

1.09 COORDINATION

- A. Coordinate installation of EIFS with related Work specified in other Sections to ensure that wall assemblies, including sheathing, weather-resistant sheathing paper, flashing, trim, joint sealants, windows, and doors, are protected against damage from the effects of weather, age, corrosion, moisture, and other causes. Do not allow water to penetrate behind flashing and drainage plane that is behind water-drainage EIFS.
- B. Coordinate installation of EIFS with related Work specified in other Sections to ensure that wall assemblies, including sheathing, weather-resistant sheathing, flashing, trim, joint sealants, windows, and doors, are protected against damage from the effects of weather, age, corrosion, moisture, and other causes. Do not allow water to penetrate behind flashing and barrier coating of EIFS.

1.10 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of EIFS-clad drainage-wall assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Bond integrity and weathertightness.
 - b. Deterioration of EIFS finishes and other EIFS materials beyond normal weathering.
 - 2. Warranty coverage includes the following components of EIFS-clad drainage-wall assemblies:
 - a. EIFS finish, including base coats, finish coats, and reinforcing mesh.
 - b. Insulation installed as part of EIFS including foam build-outs.
 - c. Insulation adhesive and mechanical fasteners.
 - d. EIFS accessories, including trim components and flashing.
 - e. Water-resistive coatings.
 - f. EIFS drainage components.
 - 3. Warranty Period: Five years from date of Substantial Completion.
- B. Special Project Warranty: EIFS Installer's agrees to repair or replace components of EIFS-clad drainage-wall assemblies that fail in materials or workmanship within the following warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Warranty: Provide for assignment of warranty to new owner if facility is sold.
- D. Legal Forum Selection: State where project is located or State of Tennessee.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following and; Manufacturers: Subject to compliance with requirements, provide products by manufacturers listed in Document 002150 - Owner's Preferred Vendor List. No substitutions permitted.
1. Dryvit Systems, Inc., West Warwick, RI.
 2. Sto Corp.
 3. Substitutions: None allowed.
- B. Basis of Design: Sto Corp.; StoTherm Classic NExT.

2.02 PERFORMANCE REQUIREMENTS

- A. EIFS Performance: Comply with the following:
1. Bond Integrity: Free from bond failure within EIFS components or between system and supporting wall construction, resulting from exposure to fire, wind loads, weather, or other in-service conditions.
 2. Weathertightness: Resistant to water penetration from exterior into water-drainage EIFS and assemblies behind it or through them into interior of building that results in deterioration of thermal-insulating effectiveness or other degradation of EIFS and assemblies behind it, including substrates, supporting wall construction, and interior finish, and including a means that allows water entering into an EIFS assembly to drain to the exterior.
- B. Class PB EIFS: Provide EIFS having physical properties and structural performance that comply with the following:
1. Abrasion Resistance: Sample consisting of 1-inch-(25.4-mm-) thick EIFS mounted on 1/2-inch-(12.7-mm-) thick gypsum board; cured for a minimum of 28 days; and showing no cracking, checking, or loss of film integrity after exposure to 528 quarts(500 L) of sand when tested per ASTM D 968, Method A.
 2. Absorption-Freeze Resistance: No visible deleterious effects and negligible weight loss after 60 cycles per EIMA 101.01.
 3. Accelerated Weathering: Five samples per ICC-ES AC235 showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, delamination, or other characteristics that might affect performance as a wall cladding after testing for 2000 hours when viewed under 5 times magnification per ASTM G 153 or ASTM G 155.
 4. Freeze-Thaw: No surface changes, cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination, or indications of delamination between components when viewed under 5 times magnification after 10 cycles per ICC-ES AC235.
 5. Mildew Resistance of Finish Coat: Sample applied to 2-by-2-inch (50.8 by-50.8-mm) clean glass substrate, cured for 28 days, and showing no growth when tested per ASTM D 3273 and evaluated according to ASTM D 3274.
 6. Tensile Adhesion: No failure in the EIFS, adhesive, base coat, or finish coat when tested per ICC-ES AC235.
 7. Water Penetration: Sample consisting of 1-inch-(25.4-mm-) thick EIFS mounted on 1/2-inch-(12.7-mm-) thick gypsum board, cured for 28 days, and showing no water penetration into the plane of the base coat to expanded polystyrene board interface of the test specimen after 15 minutes at 6.24 lbf/sq. ft.(299 Pa) of air pressure difference or 20 percent of positive design wind pressure, whichever is greater, across the specimen during a test period when tested per EIMA 101.02.
 8. Water Resistance: Three samples, each consisting of 1-inch-(25.4-mm-) thick EIFS mounted on 1/2-inch-(12.7-mm-) thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination after testing for 14 days per ASTM D 2247.
 9. Impact Resistance: Sample consisting of 1-inch-(25.4-mm-) thick EIFS when constructed, conditioned, and tested per EIMA 101.86; and meeting or exceeding the following:

- a. Standard Impact Resistance: 25 to 49 inch-lb (2.8 to 5.6 J).
- b. High Impact Resistance: 90 to 150 inch-lb (10.2 to 17 J).
- 10. Drainage: According to ICC-ES AC235.
- 11. Structural Performance Testing: EIFS assembly and components shall comply with ICC-ES AC235 when tested per ASTM E 330.

2.03 MATERIALS

- A. Compatibility: Provide liquid-applied air/moisture barrier, adhesive, board insulation, reinforcing meshes, base- and finish-coat systems, sealants, and accessories that are compatible with one another and with substrates and approved for use by EIFS manufacturer for Project.
- B. Liquid-Applied Air/Moisture Barrier: EIFS manufacturer's standard formulation and accessories for use as water/weather-resistive barriers, compatible with substrate, and complying with physical and performance criteria of ICC-ES AC212.
 - 1. Sheathing Joint Compound and Self-Adhesive Mesh: Type recommended by EIFS manufacturer for sealing joints between and penetrations through sheathing, perimeters of sheathing, perimeters of rough openings, and other locations and conditions recommended by manufacturer.
 - 2. VOC Content of Coatings Used as Insulation Adhesive: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Insulation Adhesive: EIFS manufacturer's standard formulation designed for indicated use; specifically formulated to be applied to back side of insulation in a manner that creates open vertical channels designed to serve as an integral part of the water-drainage system of the EIFS-clad drainage-wall assembly; compatible with substrate; and complying with the following:
 - 1. Factory-mixed, single-component, polymer-modified, cement-based dry powder material; self-gauging to achieve 1/16 inch (1.6 mm) base coat thickness in a single coat application.
 - 2. Wood Substrates: Factory-mixed non-cementitious formulation designed for adhesive attachment of insulation to substrates of type indicated, self-gauging to achieve 1/16 inch (1.6 mm) base coat thickness in a single coat application as recommended by EIFS manufacturer.
- D. Molded or Extruded, Rigid Cellular Polystyrene Board Insulation: Comply with ASTM C 578, Type I or Type IV; EIFS manufacturer's requirements; and EIMA's "EIMA Guideline Specification for Expanded Polystyrene (EPS) Insulation Board" for most stringent requirements for material performance and qualities of insulation, including dimensions and permissible variations, and the following:
 - 1. Aging: Before cutting and shipping, age insulation in block form by air drying for not less than 6 weeks or by another method approved by EIMA that produces equivalent results.
 - 2. Flame-Spread and Smoke-Developed Indexes: 25 and 450 or less, respectively, per ASTM E 84.
 - 3. Dimensions: Provide insulation boards not more than 24 by 48 inches (610 by 1219 mm) and in thickness indicated but not more than 4 inches (102 mm) thick or less than thickness allowed by ASTM C 1397.
 - 4. Foam Shapes: Provide with profiles and dimensions indicated on Drawings.
- E. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multi-end strands with retained mesh tensile strength of not less than 120 lbf/in. (21 dN/cm) per ASTM E 2098; complying with ASTM D 578 and the following:
 - 1. Standard-Impact Reinforcing Mesh: Not less than 4.0 oz./sq. yd. (136 g/sq. m).
 - 2. High-Impact Reinforcing Mesh: Not less than 15 oz./sq. yd. (509 g/sq. m).
 - 3. Strip Reinforcing Mesh: Not less than 3.75 oz./sq. yd. (127 g/sq. m).
 - 4. Detail Reinforcing Mesh: Not less than 4.0 oz./sq. yd. (136 g/sq. m).
 - 5. Corner Reinforcing Mesh: Not less than 7.2 oz./sq. yd. (244 g/sq. m).
- F. Base-Coat Materials: EIFS manufacturer's standard mixture complying with the following requirements:

1. Factory-mixed, single-component, polymer-modified, cement-based dry powder material; self-gauging to achieve 1/16 inch (1.6 mm) base coat thickness in a single coat application.
 2. Factory-mixed non-cementitious formulation of polymer-emulsion adhesive and inert fillers that is ready to use without adding other materials.
- G. Finish-Coat Materials: EIFS manufacturer's standard acrylic-based coating complying with the following:
1. Sealer: Manufacturer's waterproof, clear acrylic-based sealer for protecting finish coat.
 2. Colors: As selected by Architect from manufacturer's full range.
- H. Water: Potable.

2.04 TRIM ACCESSORIES

- A. General: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D 1784, manufacturer's standard Cell Class for use intended, and ASTM C 1063.
- B. Weep Screed/Starter Track:
1. Prefabricated, one-piece extruded PVC type for attachment behind insulation with perforated face leg sloped and extended to form a drip, weep holes in track bottom of depth required to suit thickness of coating and insulation.
 2. Face leg to be perforated for bonding to coating and back leg; designed to drain incidental moisture that gets into wall construction to the exterior at terminations of EIFS with drainage.
 3. Thickness: 1/16 inch.
 4. Width: As required to receive scheduled insulation thickness.
 5. Basis of Design Products:
 - a. Vinyl Corporation No. CBS-16SDWF Starter Strip/Casing Bead.
 - b. Plastic Components; No. STDE.
- C. Window Sill Flashing: Prefabricated type 0.032 inch prefinished aluminum with drip for both flashing and sloping sill over framing beneath windows; with end and back dams; designed to direct water to exterior.
- D. Window Head Flashing: Prefabricated type, 0.032 inch prefinished aluminum with drip designed to direct water to exterior.

2.05 ELASTOMERIC SEALANTS

- A. Elastomeric Sealant Products: Provide EIFS manufacturer's listed and recommended chemically curing, elastomeric sealant that is compatible with joint fillers, joint substrates, and other related materials, and complies with requirements for products and testing indicated in ASTM C 1481 and with requirements in Division 07 Section "Joint Sealants" for products corresponding to description indicated below:
1. Single-component, nonsag, neutral-curing silicone sealant.
- B. Sealant Color: As selected by Architect from manufacturer's full range.

2.06 MIXING

- A. General: Comply with EIFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by EIFS manufacturer. Mix materials in clean containers. Use materials within time period specified by EIFS manufacturer or discard.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of EIFS.
- B. Examine roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where EIFS will be installed.

- C. Substrate:
 - 1. Inspect the substrate to determine if it is in accordance with the Drawings, Specifications, and EIFS manufacturer's requirements.
 - 2. Promptly correct deficiencies.
 - 3. Acceptance of substrate, as further confirmed by commencement of EIFS application, precludes asserting substrate problems as a defense for product failure during the warranty period.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Begin coating application only after surfaces are dry.
 - 2. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Protect contiguous work from moisture deterioration and soiling caused by application of EIFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.
- B. Protect EIFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind drainage plane of EIFS and deterioration of substrates.
- C. Prepare and clean substrates to comply with EIFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.

3.03 EIFS INSTALLATION, GENERAL

- A. Comply with EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate indicated.

3.04 SUBSTRATE PROTECTION APPLICATION

- A. Liquid-Applied Air/Moisture Barriers: Apply over substrates to protect substrates from degradation and to provide water-/weather-resistive barrier.
 - 1. Ensure joints, exposed edges, terminations, and inside and outside corners of sheathing are sealed unless otherwise indicated by EIFS manufacturer's written instructions.

3.05 TRIM INSTALLATION

- A. Trim: Apply trim accessories according to EIFS manufacturer's written instructions. Coordinate with installation of insulation.
 - 1. Weep Screed/Starter Track: Use at bottom termination edges of water-drainage EIFS unless otherwise indicated. Provide splices and seal joints, intersections, and ends ensuring weeps remain clear.
 - 2. Window Sill and Head Flashing: Use at windows unless otherwise indicated.

3.06 INSULATION INSTALLATION

- A. Board Insulation: Adhesively attach insulation to substrate in compliance with ASTM C 1397, EIFS manufacturer's written instructions, and the following:
 - 1. Apply adhesive on back of insulation by notched-trowel method in a manner that results in ridges forming vertical drainage channels leaving channels free of adhesive once insulation is adhered to substrate. Use properly sized notched trowel as recommended by manufacturer providing vertical drainage channels spaced as recommended by manufacturer.
 - 2. Apply adhesive to a thickness of not less than 1/4 inch (6.4 mm), measured from surface of insulation before placement.
 - 3. Press insulation into place maintaining channels free of adhesive. Apply pressure over the entire surface of insulation to accomplish uniform contact, high initial grab, and overall level surface.
 - 4. Allow adhered insulation to remain undisturbed for period recommended by EIFS manufacturer, but not less than 24 hours, before beginning rasping and sanding insulation, or applying base coat and reinforcing mesh.
 - 5. Begin first course of insulation from weep screed/starter track and work upward.

6. Stagger vertical joints of insulation boards in successive courses to produce running bond pattern. Locate joints so no piece of insulation is less than 12 inches (300 mm) wide or 6 inches (150 mm) high. Offset joints not less than 6 inches (150 mm) from corners of window and door openings and not less than 4 inches (100 mm) from aesthetic reveals.
 - a. Adhesive Attachment: Offset joints of insulation not less than 6 inches (150 mm) from horizontal and 4 inches (100 mm) from vertical joints in sheathing.
 7. Interlock ends at internal and external corners.
 8. Abut insulation tightly at joints within and between each course to produce flush, continuously even surfaces without gaps or raised edges between boards. If gaps greater than 1/16 inch (1.6 mm) occur, fill with insulation cut to fit gaps exactly; insert insulation without using adhesive or other material.
 - a. Spray foam approved by manufacturer may be used in lieu of insulation strips.
 9. Cut insulation to fit openings, corners, and projections precisely and to produce edges and shapes complying with details indicated.
 10. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than 1/16 inch (1.6 mm) from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than 1/16 inch (1.6 mm).
 11. Cut aesthetic reveals in outside face of insulation with high-speed router and bit configured to produce grooves, rabbets, and other features that comply with profiles and locations indicated. Do not reduce insulation thickness at aesthetic reveals to less than 3/4 inch (19 mm).
 12. Install foam shapes and attach to sheathing.
 13. Interrupt insulation for expansion joints where indicated.
 14. After installing insulation and before applying field-applied reinforcing mesh, fully wrap board edges. Cover edges of board and extend encapsulating mesh not less than 2-1/2 inches (64 mm) over front and back face unless otherwise indicated on Drawings.
 15. Treat exposed edges of insulation as follows:
 - a. Except for edges forming substrates of sealant joints, encapsulate with base coat, reinforcing mesh, and finish coat.
 - b. Encapsulate edges forming substrates of sealant joints within EIFS or between EIFS and other work with base coat and reinforcing mesh.
 - c. At edges trimmed by accessories, extend base coat, reinforcing mesh, and finish coat over face leg of accessories.
 16. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and liquid-applied air/moisture barrier.
- B. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch (9 mm) OD by 4 inches (100 mm) long.

3.07 BASE-COAT INSTALLATION

- A. Base Coat: Apply to exposed surfaces of insulation and foam shapes in minimum thickness recommended in writing by EIFS manufacturer, but not less than 1/16-inch(1.6-mm) dry-coat thickness.
- B. Reinforcing Mesh: Embed type indicated below in wet base coat to produce wrinkle-free installation with mesh continuous at corners and overlapped not less than 2-1/2 inches(64 mm) or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written instructions. Do not lap reinforcing mesh within 8 inches (204 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are not visible.
 1. Standard-impact reinforcing mesh unless otherwise indicated.
 2. High-impact reinforcing mesh where indicated. Butt joints; do not overlap.
 3. Provide impact-resistant reinforcing mesh at ground floor to a minimum height of 10 feet, stopping only at a joint, reveal, or change in plane.
- C. Double-Layer Reinforcing Mesh Application: Where indicated, apply second base coat and second layer of standard-impact reinforcing mesh, overlapped not less than 2-1/2 inches(64 mm) or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's

written instructions in same manner as first application. Do not apply until first base coat has cured.

- D. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings extending 4 inches (100 mm) beyond perimeter. Apply additional 9-by-12-inch (230-by-300-mm) strip reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch-(200-mm-) wide strip reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches (100 mm) on each side of corners.
 - 1. At aesthetic reveals, apply strip reinforcing mesh not less than 8 inches (200 mm) wide.
 - 2. Embed strip reinforcing mesh in base coat before applying first layer of reinforcing mesh.
- E. Foam Shapes: Fully embed reinforcing mesh in base coat.

3.08 FINISH-COAT INSTALLATION

- A. Finish Coat: Apply over dry base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by EIFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.
 - 1. Texture: As selected by Architect from manufacturer's full range.
- B. Sealer Coat: Apply over dry finish coat, in number of coats and thickness required by EIFS manufacturer.

3.09 INSTALLATION OF JOINT SEALANTS

- A. Prepare joints and apply sealants, of type and at locations indicated, to comply with applicable requirements in Division 07 Section "Joint Sealants" and in ASTM C 1481.
 - 1. Apply joint sealants after base coat has cured but before applying finish coat.
 - 2. Clean surfaces to receive sealants to comply with indicated requirements and EIFS manufacturer's written instructions.
 - 3. Apply primer recommended in writing by sealant manufacturer for surfaces to be sealed.
 - 4. Install sealant backing to control depth and configuration of sealant joint and to prevent sealant from adhering to back of joint.
 - 5. Apply masking tape to protect areas adjacent to sealant joints. Remove tape immediately after tooling joints, without disturbing joint seal.

3.10 FIELD QUALITY CONTROL

- A. Correct deficiencies in or remove and replace EIFS that inspections and test reports indicate do not comply with requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected Work with requirements.
- C. System Manufacturer's Field Services:
 - 1. Utilize form included with this Section. This form is for minimum observation criteria only and does not exclude any additional observation information that may be relevant. Carry over any noted deficiencies in subsequent report and note re-observation and corrective measures.
 - 2. Provide a detailed examination of the Project at the following process steps:
 - a. Review sample panel for proper detailing of junctions of differing products with the EIFS including relief details, roof parapet details, control joints, doors, substrata, flashing, and joint sealants.
 - b. Attend Preinstallation Conference.
 - c. First floor substrate including the high impact resistant system.
 - d. First floor foam application process, base coat application and finish coat.
 - e. Subsequent floors during the same stages.
 - f. Flashing and termination points of the system and sealants.
 - g. Final observation of overall Project.
 - 3. Conduct classes with Contractor as to product types, process, installation issues, substrate concerns, and other issues relevant to EIFS.
 - 4. System manufacturer to observe and report on EIFS installation.

5. Promptly notify Contractor and Architect in writing when any unacceptable condition is observed.
6. Advise Contractor on corrective measures and the impact on the EIFS schedule of installation.

3.11 CLEANING AND PROTECTION

- A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive EIFS coatings.

3.12 ATTACHMENT

- A. HCA EIFS Quality Assurance Program Project Observation Form

END OF SECTION

HCA

The Healthcare Company
Design, Construction, Equipment, Engineering Services
EIFS Quality Assurance Program

Project Observation Form

Date		
Manufacturer		
Project	Name	
	City/State	
	Building Type	
Architect	Firm	
	City/State	
	Contact/Phone number	
Manufacturer	Representative name	
	City/State	
	Contact/Phone number	
Subcontractor	Name	
	City/State	
	Contact/Phone number	

Observation

Area (bldg location)	Item Reviewed	Status of Work	Description of Deficiencies	Corrective Action Necessary

Defective prior work review

Date of prior observation	Area (bldg location)	Item Reviewed	Status of Work	Description of Deficiencies	Corrective Action Necessary
	Actual corrective action and effectiveness				

Observer & Date: _____

General Contractor & Date: _____

Distribution:

File Legal Sales
Manager General Contractor Owner

SECTION 07 25 00
WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.02 RELATED REQUIREMENTS

- A. Section 07 24 00 - Exterior Insulation and Finish Systems: Water-resistive barrier under exterior insulation.

1.03 DEFINITIONS

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

1.04 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- E. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.
- F. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; ICC Evaluation Service, Inc; 2015.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- C. Shop Drawings: Provide drawings of special joint conditions.

1.06 MOCK-UP

- A. Install air barrier and water-resistive barrier materials in mock-up specified in Section 042000.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

- A. Air Barrier:
 - 1. On outside surface of sheathing of exterior walls use air barrier coating.

2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
 - 1. Air Barrier Coating:
 - a. Dry Film Thickness (DFT): 10 mil, 0.010 inch, minimum.
 - b. Air Permeance: 0.001 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.
 - c. Water Vapor Permeance: 18 perms, minimum, when tested in accordance with ASTM E96/E96M, Procedure B.

- d. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to six months of weather exposure after application.
- e. Elongation: 300 percent, minimum, when tested in accordance with ASTM D412.
- f. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- g. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
- h. Code Acceptance: Comply with applicable requirements of ICC-ES AC212.
- i. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
- j. Manufacturers:
 - 1) 3M Company; ____: www.3M.com/construction/#sle.
 - 2) Master Wall, Inc; Rollershield LAB System: www.masterwall.com/#sle.
 - 3) Parex USA, Inc; Parex USA WeatherSeal Spray & Roll-on: www.parexusa.com/#sle.

2.03 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
- B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
 - 1. Composition: Any material that meets physical requirements of ASTM D1970/D1970M with exceptions indicated.
 - 2. Thickness: 70 mil, 0.070 inch, nominal.
- C. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Coatings:
 - 1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
 - 2. Use flashing to seal to adjacent construction and to bridge joints.
- D. Openings and Penetrations in Exterior Weather Barriers:
 - 1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
 - 2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
 - 3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
 - 4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
 - 5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.

6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Coordination of ABAA Tests and Inspections:
 1. Provide testing and inspection required by ABAA QAP.
 2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
 3. Cooperate with ABAA testing agency.
 4. Allow access to air barrier work areas and staging.
 5. Do not cover air barrier work until tested, inspected, and accepted.
- C. Obtain approval of installation procedures by the weather barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.

3.05 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 54 23
THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Adhered TPO membrane roofing system.
 - 2. Mechanically fastened TPO membrane roofing system.
 - 3. Vapor retarder.
 - 4. Roof insulation.
- B. Section includes the installation of acoustical roof deck rib insulation strips furnished under Division 05 Section "Steel Decking".
- C. Related Sections:
 - 1. Retain Sections in subparagraphs below that contain requirements Contractor might expect to find in this Section but are specified in other Sections.
 - 2. Document 002150 Preferred Vendors and Manufacturers
 - 3. Division 06 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
 - 4. Division 06 Section "Wood Sheathing" for wood-based, structural-use roof deck panels.
 - 5. Division 07 Section "Preparation for Re-Roofing" for recover board beneath new membrane roofing.
 - 6. Division 07 Section "Thermal Insulation" for insulation beneath the roof deck.
 - 7. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
 - 8. Division 07 Section "Manufactured Roof Expansion Joints" for proprietary manufactured roof expansion-joint assemblies.
 - 9. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
 - 10. Division 22 Section "Storm Damage Piping Specialties" for roof drains.

1.02 DEFINITIONS

- A. TPO: Thermoplastic polyolefin.
- B. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.
- C. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems", before multiplication by a safety factor.

1.03 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
 - 1. Corner Uplift Pressure: Varies, see Structural Drawings.
 - 2. Perimeter Uplift Pressure: Varies, see Structural Drawings.
 - 3. Field-of-Roof Uplift Pressure: Varies, see Structural Drawings.
- D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a

membrane roofing system, and that are listed in FM Approvals "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

1. Fire/Windstorm Classification: Class 1A-90
 2. Hail-Resistance Rating: SH.
- E. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- F. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- G. Energy Performance: Provide roofing system with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.

1.04 ACTION SUBMITTALS

- A. Prepare submittals per requirements of Section 01 3300 – Submittal Procedures.
- B. Product Data: Include information evidencing compliance with specified requirements.
1. Roofing membrane.
 2. Roof insulation.
 3. Installation accessories.
- C. Certificates and Warranties
1. Sample Manufacturer's Warranty.
 2. Sample Contractor's Warranty.
 3. Certificate of UL compliance.
 4. Certificate of FM compliance when applicable.
- D. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
1. Base flashings and membrane terminations.
 2. Tapered insulation, including slopes.
 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
 5. Sheet layout.
 6. Penetration locations and details.
- E. Samples for Verification:
1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
 2. Roof insulation.
 3. Walkway pads or rolls.
 4. Metal termination bars.
 5. Battens.
 6. Six insulation fasteners of each type, length, and finish.
 7. Six roof cover fasteners of each type, length, and finish.

1.05 INFORMATIONAL SUBMITTALS

- A. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.
- B. Certification: Submit manufacturer's signed statement that Project design and conditions have been reviewed and that the installation will be fully warrantable if correctly installed. This submittal may be in the form of a photocopy of manufacturer's authorization to Installer to proceed with installation.
- C. Preinstallation meeting records.
- D. Manufacturer's Inspections: Submit copies of inspection reports and punch lists prepared by representatives of membrane manufacturer within 2 working days of their receipt by Installer.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

- B. Manufacturer warranties.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL Listed for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including fasteners and roof insulation for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
 - 1. Installer shall have 10 years' experience in application of specified system.
 - 2. Provide authorization letter on manufacturer's letterhead, signed by an officer of the company and shall state that the Roofing Contractor is approved to install specified system.
- D. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- E. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 - 7. Review governing regulations and requirements for insurance and certificates if applicable.
 - 8. Review temporary terminations and procedures for evaluating water infiltration during construction.
 - 9. Review temporary protection requirements for roofing system during and after installation.
 - 10. Review roof observation and repair procedures after roofing installation.
- F. Preinstallation Roofing Conference: Conduct conference at Project site. Comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 - 7. Review governing regulations and requirements for insurance and certificates if applicable.

8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.
- G. Manufacturer's Field Services during Construction:
1. Have a trained technical representative on the site for the first full 3 days of operations of the work of this Section, and at regular intervals of 10 to 14 days during the roof construction period to perform onsite inspections.
 2. Provide detailed field inspection reports to the Architect, the Contractor and the roofing subcontractor within 5 days of the initial 30day work period, and within 5 days of each periodic on-site inspection.
 3. Provide a detailed final, field inspection of the completed roofing installation. Inspection is to identify all conditions that would prohibit the manufacturer from issuing the system warranty for the installed roofing system. Issue final inspection report within 10 working days of inspection. Submit report of the Architect, Contractor, Owner, and Roofing Contractor.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.09 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
 1. Special warranty includes membrane roofing and base flashings and other components of membrane roofing system.
 2. Warranty coverage to include materials, watertightness and workmanship.
 3. Warranty Period: 20 years from date of Substantial Completion.
 - a. The date all warranty criteria has been satisfied; or
 - b. The date the warranty fee is paid; or
 - c. The Date of Substantial Completion.

PART 2 PRODUCTS

2.01 TPO MEMBRANE ROOFING

- A. Fabric-Reinforced Fleece Backed Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.
 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers listed on the Owner's Preferred Vendor List, Document 002150:
 - a. Carlisle SynTec Incorporated.
 - b. Fiber-Tite/Seaman Corporation.

- c. GenFlex Roofing Systems.
- d. Firestone Building Products Company.
- e. Sarnafil/Sika Group.
- f. No substitutions permitted.
- 2. Thickness: 115 mils total membrane thickness consisting of 60 mils thick, fire retardant TPO membrane laminated to 55 mils thick non-woven polyester fleece backing.
- 3. Exposed Face Color: White.

2.02 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Contact Adhesive: 80 g/L.
 - f. Other Adhesives: 250 g/L.
 - g. Single-Ply Roof Membrane Sealants: 450 g/L.
 - h. Nonmembrane Roof Sealants: 300 g/L.
 - i. Sealant Primers for Nonporous Substrates: 250 g/L.
 - j. Sealant Primers for Porous Substrates: 775 g/L.
- B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 60 mils (1.5 mm) thick, minimum, of same color as sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard, water based.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.03 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (13mm) thick.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Georgia-Pacific Corporation; Dens Deck.
- B. Substrate Board: ASTM C 1278/C 1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate, 1/2 inch thick.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. USG Corporation; Securock.
- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.04 VAPOR RETARDER

- A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).
 - 1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
 - 2. Adhesive: Manufacturer's standard lap adhesive, FM Approvals approved for vapor-retarder application.
- B. Laminated Sheet: Kraft paper, two layers, laminated with asphalt and edge reinforced with woven fiberglass yarn with maximum permeance rating of 0.50 perm (29 ng/Pa x s x sq. m) and with manufacturer's standard adhesive.

2.05 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured [or approved] by TPO membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated [and that produce FM Approvals-approved roof insulation].
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.06 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation[and cover boards] to substrate, and acceptable to roofing system manufacturer.
- C. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch thick, factory primed.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Georgia-Pacific Corporation; Dens Deck.
- E. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.07 ASPHALT MATERIALS

- A. Roofing Asphalt: ASTM D 312, Type III or Type IV.
- B. Asphalt Primer: ASTM D 41.

2.08 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- D. Install acoustical roof deck rib insulation strips, specified in Division 05 Section "Steel Decking," according to acoustical roof deck manufacturer's written instructions, immediately before installation of overlying construction and to remain dry.

3.03 SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
 2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

3.04 VAPOR-RETARDER INSTALLATION

- A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively.
 1. Continuously seal side and end laps with tape.
- B. Laminate Sheet: Install laminate-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively. Bond vapor retarder to substrate as follows:
 1. Apply adhesive at rate recommended by vapor-retarder manufacturer. Seal laps with adhesive.
- C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.05 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
 - 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- G. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
- H. Mechanically Fastened and Adhered Insulation: Install each layer of insulation and secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten first layer of insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
 - 3. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- I. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.
 - 1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
- J. Install slip sheet over [insulation] [cover board] and immediately beneath membrane roofing.

3.06 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Provide means of screening airborne spray adhesive particles from migrating away from the area of application. Take particular measures to prohibit particle intake into mechanical system outside air intake openings.
- B. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.
- C. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
- D. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

- F. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- G. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- H. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- I. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.
- J. Install membrane roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing membrane roofing system.

3.07 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings[and mechanically anchor to substrate through termination bars].

3.08 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.
- B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions in locations indicated, to form walkways. Leave 3 inches (75 mm) of space between adjacent roof pavers.

3.09 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition

free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <Insert Name> of <Insert Address>, herein called the "Roofing Installer", has performed roofing and associated work ("work:") on the following project:
 - Owner: <Insert name of Owner>.
 - Address: <Insert address>.
 - Building Name/Type: <Insert information>.
 - Address: <Inspect address>.
 - Area of Work: <Insert information>.
 - Acceptance Date: <Insert date>.
 - Warranty Period: <Insert time>.
 - Expiration Date: <Insert date>.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designed Warranty Period.
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty or defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
 - 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. Lightning;
 - b. Peak gust wind speed exceeding 72 mpg (32.2m/sec);
 - c. Fire;
 - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. Vapor condensation on bottom of roofing; and
 - g. Activity on roofing by others, including construction contractors, maintenance personnel, other person, and animals, whether authorized or unauthorized by Owner.
 - 2. When work has been damaged by an of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expanse thereof have been paid by Owner or by another responsible party so designated.
 - 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 - 4. During Warranty Period, if Owner allows alteration of work by anyone other than penetrations, attachment of other work, and positioning of anyone on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alternations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 - 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become

null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontractor with Owner's General Contractor.
- E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.
Authorized Signature: <Insert signature>.
Name: <Insert name>.
Title: <Insert title>.

END OF SECTION

SECTION 07 65 00
FLEXIBLE FLASHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Laminated stainless steel fabric flashing, non-asphaltic.
- B. Related sections:
 - 1. 04 05 23 Masonry Accessories.
 - 2. 04 21 13 Brick Masonry
 - 3. 04 22 00 Concrete Unit Masonry
 - 4. 04 22 23 Architectural Concrete Unit Masonry
 - 5. 04 42 00 Exterior Stone Cladding.
 - 6. 04 72 00 Cast Stone Masonry.
 - 7. 05 40 00 Cold Formed Metal Framing.
 - 8. 06 10 00 Rough Carpentry.
 - 9. 07 11 10 Dampproofing.
 - 10. 07 60 00 Flashing and Sheet Metal.
 - 11. 07 65 00 Flexible Flashing.

1.02 REFERENCES

- A. Standards of the following as referenced:
 - 1. ASTM
 - 2. Brick Industry Association (BIA)
 - 3. Recycled content & Recyclability
- B. Industry standards:
 - 1. BIA Technical Notes on Brick Construction No. 7, Water Penetration Resistance- Design and Detailing, August 2005.
 - 2. BIA Technical Notes on Brick Construction No. 28B, Brick Veneer/Steel Stud Walls, August 2005.

1.03 DEFINITIONS

- A. Terms:
 - 1. Cavity wall flashing: Same as flexible flashing.
 - 2. Foundation sill flashing: Same as flexible flashing.
 - 3. Flexible flashing: Water-proof material typically used in cavity wall construction to contain and assist in the proper water drainage that may penetrate wall system veneer. Other materials may be required to constitute the system.
 - 4. Head and sill flashing: Same as flexible flashing.
 - 5. Through-wall flashing:
 - a. Generally considered the same as flexible flashing.
 - b. Rare definition referred to full width cap flashing under copings or wall caps.

1.04 SUBMITTALS

- A. Product data: Indicate material type, composition, thickness, and installation procedures.
- B. Samples: 3" by 5" flashing material.
- C. Product Quality & Environmental submittals:
 - 1. Certificates:
 - a. Indicate materials supplied or installed are asbestos free.
 - b. Indicate recycled content: 60% total recycled material; based on 60% Post Industrial Recycled Content.
 - 2. PERFORMANCE ATTRIBUTES
 - a. TENSILE STRENGTH, >90,000 PSI MINIMUM
 - b. PUNCTURE RESISTANCE, >2,500 POUNDS AVERAGE

- c. When tested as manufactured, product resists growth of mold pursuant to test method ASTM D3273.
- d. Certify the use of domestic manufactured stainless steel for flashing.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Provide flashing materials by single manufacturer with not less than twenty five years of experience in manufacturing flexible flashing products.
 - 2. Flashing materials must be able to withstand 400° F temperature without changing the long term performance of the flashing.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

- A. Flexible flashing:
 - 1. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, except as modified below, are acceptable for use, subject to compliance with specified requirements.
 - a. Product standard of quality:
 - 1) York Manufacturing, Inc.; York 304 SS
 - 2) STS Coatings, Inc.; Gorilla Flash SS peel & stick butyl
 - 3) Illinois Products, Inc.; IPCO Self-Adhesive Stainless Steel
 - 4) TK Products, Inc.; TK Self-Adhering Stainless Steel TWF
 - 5) Other products that meet the criteria in section 1.04 to 1.06.
 - b. Characteristics:
 - 1) Type: Stainless steel core with one stainless steel face with a butyl block co-polymer adhesive.
 - 2) Stainless steel type: 304, ASTM A167.
 - 3) Adhesive: block co-polymer
 - 4) Size: Manufacturer's standard width rolls.
- B. Accessories:
 - 1. Polyether sealant:
 - a. York Manufacturing, Inc.; UniverSeal US-100
 - b. STS Coatings; GreatSeal LT-100
 - c. Prosoco, Inc.; R-Guard Joint Seam Sealer
 - 2. Splice Tape:
 - a. York Manufacturing, Inc.; York 304 SS
 - b. Illinois Products, Inc.; IPCO Self Adhering Stainless Steel Flashing
 - 3. Corner and End Dams: form the stainless steel flashing in the field or use 26 gauge stainless steel pre-manufactured corners.
 - 4. Mortar deflection: polyester strands that will not degrade and will keep weep vents from clogging with mortar.
 - a. York Manufacturing; Weep-Armor
 - b. Or approved comparable product
 - 5. Termination bar: rigid PVC or stainless steel termination bar with sealant catch lip
 - a. York Manufacturing; T-96 termination bar
 - b. York Manufacturing; SS Term Bar

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Install where indicated, specified, or required in accord with flashing manufacturer's written instructions and as follows.
 - 2. Extend flashing 6" minimum beyond opening. Fold flashing ends at end of openings or horizontal flashing terminations to form end dam or use pre-manufactured units made of 26 gauge stainless steel.

3. Flashing width: Width required starting flush with outside face of exterior wythe, extending through cavity, rising height required to extend above lintel steel at least 2".
4. Splice end joints by overlapping them a minimum of 2" and seal with a compatible sealant or metal splice tape.
5. Masonry back up:
 - a. Surface apply after dampproofing installation specified in Damp proofing/Air Barrier Section in accord with manufacturer's installation instructions.
 - b. b. Fasten to masonry back-up surface at top by embedding in layer of sealant or use a non-corrosive termination bar and fasten it to the backer wall at the top edge of the flashing and seal the top edge with compatible sealant or use a termination clamp, which is embedded in the block back up wall.
6. Concrete back up:
 - a. Surface apply after damp proofing/air barrier installation specified in damp proofing Section in accord with manufacturer's installation instructions.
 - b. Fasten to concrete surface at top by embedding in layer of sealant or use a non-corrosive termination bar and fasten it to the backer wall at the top edge of the flashing and seal the top edge with a compatible sealant.
7. Stud back up with sheathing:
 - a. Fasten to stud back-up at top by embedding in layer of sealant or use a non-corrosive termination bar and fasten it to the backer wall at the top edge of the flashing and seal the top edge with a compatible sealant.
8. Leave ready for certified compatible building felt or air barrier installation lapping flashing top installed in another Section.
9. Fold ends of flashing at end of opening to form dam; seal with polyether sealant or use purchased manufacturers preformed end dams.
10. Inside and outside corners: Make in industry accepted manner using corner and splice material or purchase manufactured corners from manufacturer.
11. Use stainless steel or copper drip edge any location that the underside of the flashing will be exposed and/or deemed necessary by the design professional or AHJ on the project.
12. Cover flashing within a few days of installation to protect it from damage from the different trades, the environment and falling debris. If flashing is left unprotected and it is punctured, torn, or has loose scrim you should contact the manufacturer for repair instructions.

3.02 SCHEDULES

- A. Locations:
 1. Exterior door heads.
 2. Window heads and sills.
 3. Storefront heads.
 4. Horizontal control joints.
 5. Changes in veneer materials, vertically.
 6. Other wall openings.
 7. Other locations indicated.

END OF SECTION

SECTION 07 71 00
ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured roof specialties, including copings and fascias.

1.02 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2017.
- C. NRCA (RM) - The NRCA Roofing Manual; 2017.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
- C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
- D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Roof Edge Flashings and Copings:
 - 1. Architectural Products Co; _____: www.archprod.com/#sle.
 - 2. Metal-Era Inc; _____: www.metalera.com/#sle.
 - 3. _____.
- B. Pipe and Penetration Flashings:
 - 1. Portals Plus; _____: www.portalsplus.com/#sle.

2.02 COMPONENTS

- A. Roof Edge Flashings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
 - 1. Configuration: Fascia, cant, and edge securement for roof membrane.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
- B. Copings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
 - 1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness and finish as cap; concealed stainless steel fasteners.
 - 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
 - 3. Material: Formed aluminum sheet, 0.063 inch thick, minimum.
 - 4. Finish: 70 percent polyvinylidene fluoride.
 - 5. Color: To be selected by Architect from manufacturer's standard range.
 - 6. Manufacturers:

2.03 FINISHES

- A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
- B. Seal joints within components when required by component manufacturer.
- C. Anchor components securely.
- D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.
- F. Coordinate installation of flashing flanges into reglets.

END OF SECTION

SECTION 07 72 00
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Curbs.
- B. Equipment rails.
- C. Roof penetrations mounting curbs.
- D. Roof hatches.
- E. Non-penetrating pedestals.

1.02 REFERENCE STANDARDS

- A. 29 CFR 1910.23 - Guarding floor and wall openings and holes; current edition.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- F. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
 - 1. Submit shop drawings sealed and signed by a Professional Engineer experienced in design of this type of work and licensed in Missouri.
- D. Warranty Documentation:
 - 1. Submit manufacturer warranty.
 - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

1.05 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ROOF CURBS

- A. Manufacturers:
 - 1. AES Industries Inc: www.aescurb.com.
 - 2. The Pate Company: www.patecurbs.com.
 - 3. LMCurbs; Roof Curbs: www.lmcurbs.com/#sle.
 - 4. Roof Products & Systems (RPS): www.rpscurbs.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
 - 1. Roof Curb Mounting Substrate: Curb substrate consists of corrugated metal roof deck with insulation.
 - 2. Sheet Metal Material:
 - a. Aluminum: 0.080 inch minimum thickness, with 3003 alloy, and H14 temper.
 - 1) Finish: Mill finish.
 - 3. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing system at 1:1 slope; minimum cant height 4 inches.
 - 4. Provide layouts and configurations indicated on drawings.
- C. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
 - 1. Provide preservative treated wood nailers along top of curb.
 - 2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
- D. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.
- E. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum 8 inches square unless otherwise indicated.

2.02 ROOF HATCHES AND VENTS

- A. Roof Hatch Manufacturers:
 - 1. Acudor Products Inc; Galvanized Steel Roof Hatch: www.acudor.com/#sle.
 - 2. Babcock-Davis; ThermalMAX: www.babcockdavis.com/#sle.
 - 3. Bilco Company; Type TB (various types and special size): www.bilco.com/#sle.
 - 4. Dur-Red Products: www.dur-red.com.
 - 5. Milcor, Inc: www.milcorinc.com.
 - 6. PS DOORS; Slidewise Roof Hatch: www.psddoors.com/#sle.
- B. Roof Hatches and Smoke Vents: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
 - 1. Style: Provide flat metal covers unless otherwise indicated.
 - 2. Mounting Substrate: Provide frames and curbs suitable for mounting on corrugated metal roof deck with insulation.
 - 3. Size: As indicated on drawings; single-leaf style unless indicated as double-leaf.
 - 4. For Ladder Access: Single leaf; 30 by 36 inches.
- C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
 - 1. Material: Mill finished aluminum, 11 gage, 0.0907 inch thick.
 - 2. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
 - 3. Curb Height: 12 inches from surface of roof deck, minimum.
- D. Metal Covers: Flush, insulated, hollow metal construction.
 - 1. Capable of supporting 40 psf live load.

2. Material: Mill finished aluminum; outer cover 11 gage, 0.0907 inch thick, liner 0.04 inch thick.
 3. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
 4. Gasket: Neoprene, continuous around cover perimeter.
- E. Safety Railing System: Manufacturer's standard accessory safety rail system mounted directly to curb.
1. Comply with 29 CFR 1910.23, with a safety factor of two.
 2. Posts and Rails: Aluminum tube.
 3. Gate: Same material as railing; automatic closing with latch.
 4. Finish: Manufacturer's standard, factory applied finish.
 5. Gate Hinges and Post Guides: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper aluminum.
 6. Mounting Brackets: Hot dipped galvanized steel, 1/4 inch thick, minimum.
 7. Fasteners: Stainless steel, Type 316.
 8. Manufacturers:
 - a. BILCO Company; Bil-Guard 2.0: www.bilco.com/#sle.
- F. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
 2. Hinges: Heavy duty pintle type.
 3. Hold open arm with vinyl-coated handle for manual release.
 4. Latch: Upon closing, engage latch automatically and reset manual release.
 5. Manual Release: Pull handle on interior.
 6. Locking: Padlock hasp on interior.

2.03 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

- A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
1. Design Loadings and Configurations: As required by applicable codes.
 2. Height: Provide minimum clearance of 6 inches under supported items to top of roofing.
 3. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 4. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 5. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.
- B. Pipe Supports: Provide attachment fixtures complying with MSS SP-58 and as indicated.
1. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
- C. Non-Penetrating Pedestals: Steel pedestals with square, round, or rectangular bases.
1. Bases: High density polypropylene.
 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

- A. Clean installed work to like-new condition.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 84 00
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire-resistance rated and smoke-resistant assemblies, and other openings indicated.

1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2011a.
- B. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems; 2007 (Reapproved 2011).
- C. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2010.
- D. ASTM E2837 - Standard Test Method for Determining Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2011.
- E. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- F. FM 4991 - Approval of Firestop Contractors; Factory Mutual Research Corporation; 2001.
- G. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- H. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Underwriters Laboratories Inc.; 2004.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Certificate from authority having jurisdiction indicating approval of materials used.

1.04 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Sole Source Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single sole source firestop specialty subcontractor.
- D. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Trained by the manufacturer.

2. Approved by Factory Mutual Research under FM Standard 4991, Approval of Firestop Contractors.
3. UL approved.

1.05 MOCK-UP

- A. Install one firestopping assembly representative of each fire rating design required on project.
 1. Where one design may be used for different penetrating items or in different wall or floor constructions, install one assembly for each different combination.
 2. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft.
- B. Obtain approval of authority having jurisdiction before proceeding.
- C. If accepted, mock-up will represent minimum standard for the Work.
- D. If accepted, mock-up may remain as part of the Work. Remove and replace mock-ups not accepted.

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 FIRESTOPPING - GENERAL REQUIREMENTS

- A. Manufacturers:
 1. Hilti, Inc: www.us.hilti.com. Designs specified below are taken from Hilti catalogs.
 2. Substitutions: Refer to the Owner's Preferred Vendor List in Document 002150 for other acceptable manufacturers.
- B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use any system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of the floor assembly.
 1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
 2. Temperature Rise: In addition, provide systems that have been tested to show T Rating as indicated.
 3. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
 4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.
- B. Head-of-Wall Firestopping at Joints Between Non-Rated Floor and Fire-Rated Wall: Use any system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
 1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
- C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
 1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
 2. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
 3. Watertightness: In addition, provide systems that have been tested to show W Rating as indicated.

4. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.
- D. Through Penetration Firestopping: Use any system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 1. Temperature Rise: In addition, provide systems that have been tested to show T Rating as indicated.
 2. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
 3. Watertightness: In addition, provide systems that have been tested to show W Rating as indicated.
 4. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.
- E. Definition: Where 2 hour and 3 hour construction is specified below, the the design specified is acceptable for use in applications of that rating and less.

2.03 FIRESTOPPING FOR FLOOR-TO-FLOOR, WALL-TO-FLOOR, AND WALL-TO-WALL JOINTS

- A. Concrete and Concrete Masonry Walls and Floors:
 1. Floor to Floor Joints:
 - a. 2 Hour Construction: UL System FF-D-1013; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 2. Top of Wall Joints at Concrete/Concrete Masonry Wall to Concrete Over Metal Deck Floor:
 - a. 2 Hour Construction: UL System HW-D-0181; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - b. 2 Hour Construction: UL System HW-D-1037; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 3. Top of Wall Joints at Concrete/Concrete Masonry Wall to Concrete Floor:
 - a. 3 Hour Construction: UL System HW-D-1058; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - b. 2 Hour Construction: UL System HW-D-0268; Hilti CP 606 Flexible Firestop Sealant.
 4. Concrete/Concrete Masonry Wall to Wall Joints:
 - a. 2 Hour Construction: UL System WW-D-0032; Hilti CP 606 Flexible Firestop Sealant.
- B. Gypsum Board Walls:
 1. Wall to Wall Joints:
 - a. 2 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
 2. Top of Wall Joints at Underside of Steel Beam and Concrete Over Metal Deck Floor with Sprayed On Fireproofing:
 - a. 2 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 3. Top of Wall Joints at Underside of Flat Concrete:
 - a. 2 Hour Construction: UL System HW-D-1068; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 4. Top of Wall Joints at Concrete Over Metal Deck, Wall Parallel to Ribs:
 - a. 2 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 5. Top of Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Cut to Fit Ribs:
 - a. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
 6. Top of Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Not Cut to Fit:
 - a. 2 Hour Construction: UL System HW-D-0042; Hilti CFS-SP WB Firestop Joint Spray and CP 672.

2.04 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

- A. Blank Openings:

1. In Floors or Walls:
 - a. 2 Hour Construction: UL System C-AJ-0090; Hilti FS-ONE Intumescent Firestop Sealant.
- B. Penetrations Through Floors or Walls By:
 1. Multiple Penetrations in Large Openings:
 - a. 3 Hour Construction: UL System C-AJ-1140; Hilti CP 637 Firestop Mortar.
 - b. 2 Hour Construction: UL System C-AJ-8143; Hilti FS-ONE Intumescent Firestop Sealant.
 2. Bathtub Drains:
 - a. Up to 3 Hour Construction: UL System F-A-1037, F-A-1038, F-A-2094, or F-A-2095; Hilti CP 681 Tub Box Kit.
 3. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 3 Hour Construction: UL System C-AJ-1184; Hilti FS-ONE Intumescent Firestop Sealant.
 - b. 3 Hour Construction: UL System C-AJ-1226; Hilti FS-ONE Intumescent Firestop Sealant.
 - c. 2 Hour Construction: UL System C-AJ-1498; Hilti CP 680-P/M Cast-In Device.
 4. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 3 Hour Construction: UL System C-AJ-2109; Hilti CP 643N/644 Firestop Collar.
 - b. 2 Hour Construction: UL System C-AJ-2567; Hilti FS-ONE Intumescent Firestop Sealant.
 5. Electrical Cables Not In Conduit:
 - a. 3 Hour Construction: UL System C-AJ-3095; Hilti FS-ONE Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-3216; Hilti CP 658 Firestop Plug.
 - c. 2 Hour Construction: UL System W-J-3200; Hilti CP653 Speed Sleeve.
 6. Electrical Busways:
 - a. 3 Hour Construction: UL System C-AJ-6017; Hilti FS-ONE Intumescent Firestop Sealant.
 7. Insulated Pipes:
 - a. 3 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE Intumescent Firestop Sealant.
 8. HVAC Ducts, Uninsulated:
 - a. 2 Hour Construction: UL System C-AJ-7111; Hilti FS-ONE Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System C-AJ-7084; Hilti FS-ONE Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CP 601S Elastomeric Firestop Sealant, or CP 604 Self-Leveling Firestop Sealant.
- C. Penetrations Through Floors By:
 1. Multiple Penetrations in Large Openings:
 - a. 2 Hour Construction: UL System F-A-8012; Hilti CP 604 Self-Leveling Firestop Sealant.
 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System F-A-1016; Hilti CP 680-P/M Cast-In Device.
 3. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System F-A-3033; Hilti CP 680-P/M Cast-In Device.
 4. Electrical Busways:
 - a. 2 Hour Construction: UL System F-A-6002; Hilti CP 604 Self-Leveling Firestop Sealant.
 5. Insulated Pipes:
 - a. 2 Hour Construction: UL System F-A-5015; Hilti CP 680-P/M Cast-In Device.
 - b. 2 Hour Construction: UL System F-A-5017; Hilti CP 680-P/M Cast-In Device.

D. Penetrations Through Walls By:

1. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-J-1067; Hilti FS-ONE Intumescent Firestop Sealant.
2. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System W-J-3060; Hilti FS-ONE Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
3. Insulated Pipes:
 - a. 2 Hour Construction: UL System W-J-5041; Hilti FS-ONE Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System W-J-5042; Hilti FS-ONE Intumescent Firestop Sealant.
4. HVAC Ducts, Uninsulated:
 - a. 2 Hour Construction: UL System W-J-7109; Hilti FS-ONE Intumescent Firestop Sealant or CP 606 Flexible Firestop Sealant.
5. HVAC Ducts, Insulated:
 - a. 2 Hour Construction: UL System W-J-7112; Hilti FS-ONE Intumescent Firestop Sealant.

2.05 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

A. Blank Openings:

1. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.

B. Penetrations By:

1. Multiple Penetrations in Large Openings:
 - a. 2 Hour Construction: UL System W-L-1408; Hilti FS-ONE Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System W-L-8071; Hilti FS-ONE Intumescent Firestop Sealant.
 - c. 2 Hour Construction: UL System W-L-8079; Hilti FS-ONE Intumescent Firestop Sealant.
 - d. 2 Hour Construction: UL System W-L-8087; Hilti FS 657 Fire Block.
2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-L-1054; Hilti FS-ONE Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System W-L-1164; Hilti FS-ONE Intumescent Firestop Sealant.
 - c. 2 Hour Shaftwall Construction: UL System W-L-1206; Hilti FS-ONE Intumescent Firestop Sealant.
3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
 - b. 2 Hour Construction: UL System W-L-2474; Hilti FS-ONE Intumescent Firestop Sealant.
4. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System W-L-3065; Hilti FS-ONE Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
 - b. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
 - c. 2 Hour Construction: UL System W-L-3395; Hilti CP653 Speed Sleeve.
5. Insulated Pipes:
 - a. 2 Hour Construction: UL System W-L-5028; Hilti FS-ONE Intumescent Firestop Sealant.
 - b. 2 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.

6. HVAC Ducts, Insulated:
 - a. 2 Hour Construction: UL System W-L-7156; Hilti FS-ONE Intumescent Firestop Sealant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install damming materials to arrest liquid material leakage.

3.03 3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authority having jurisdiction.
- C. Install labeling required by code.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.

1.02 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2006 (Reapproved 2011).
- B. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).
- G. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2005 (Reapproved 2010).
- H. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
 - 1. Sherwin-Williams Company; _____: www.sherwin-williams.com/#sle.
 - 2. Koroseal.
 - 3. Substitutions: Not permitted.

2.02 JOINT SEALANT APPLICATIONS

- A. Scope:
 - 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.

- d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
- 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - c. Other joints indicated below.
- 3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.
- B. Type ____ - Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
- C. Type ____ - Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
 - 1. Type ____ - Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 - 2. Type ____ - In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
 - 3. Type ____ - Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.
- D. Interior Wet Areas: Bathrooms and restrooms; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".
- F. Areas Where Tamper-Resistance is Required: As indicated on drawings.

2.03 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

2.04 NONSAG JOINT SEALANTS

- A. Type ____ - Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: _____, minimum.
 - 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 - 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 - 4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 - 5. Color: Match adjacent finished surfaces.
 - 6. Cure Type: Single-component, neutral moisture curing.
 - 7. Service Temperature Range: Minus 65 to 180 degrees F.
- B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 - 1. Color: White.
- C. Type ____ - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: Match adjacent finished surfaces.

4. Service Temperature Range: Minus 40 to 180 degrees F.
- D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
 1. Grade: ASTM C834; Grade - Minus 18 Degrees C.

2.05 SELF-LEVELING SEALANTS

- A. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 1. Composition: Multi-component, 100 percent solids by weight.
 2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
 3. Color: Concrete gray.
 4. Joint Width, Minimum: 1/8 inch.
 5. Joint Width, Maximum: 1/4 inch.
 6. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2003 (R2009).
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- I. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- K. ITS (DIR) - Directory of Listed Products; current edition.
- L. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- M. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- N. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- O. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2006.
- P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- Q. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.
- R. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- S. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.
- T. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

- U. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- V. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 3. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - 4. Technical Glass Products; SteelBuilt Window & Door Systems: www.tgpamerica.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DESIGN CRITERIA

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 - 4. Door Edge Profile: Manufacturers standard for application indicated.
 - 5. Typical Door Face Sheets: Flush.
 - 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.

7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 3. Door Thickness: 1-3/4 inch, nominal.
 4. Weatherstripping: Refer to Section 08 71 00.
 5. Door Finish: Factory primed and field finished.
- B. Interior Doors, Non-Fire Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 3. Door Thickness: 1-3/4 inch, nominal.
 4. Door Finish: Factory primed and field finished.
- C. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - a. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
 - b. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - c. Attach fire rating label to each fire rated unit.
 - d. Smoke and Draft Control Doors (Indicated with letter "S" on Drawings and/or Door Schedule): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;

- 1) Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
- 2) Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
- 3) Label: Include the "S" label on fire-rating label of door.
3. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
4. Door Thickness: 1-3/4 inch, nominal.
5. Door Finish: Factory primed and field finished.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Full profile/continuously welded type.
 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
 2. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.
 3. Weatherstripping: Separate, see Section 08 71 00.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 1. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
- E. Door Frames, Fire-Rated: Full profile/continuously welded type.
 1. Fire Rating: Same as door, labeled.
 2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- H. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 08 80 00.
- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
 1. Manufacturers:
 - a. ITW Commercial Construction North America; ITW CCNA-Buildex Tek's Select Series: www.ITWBuildex.com/#sle.
- D. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Install door hardware as specified in Section 08 71 00.
 - 1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
- E. Comply with glazing installation requirements of Section 08 80 00.
- F. Coordinate installation of electrical connections to electrical hardware items.
- G. Touch up damaged factory finishes.

3.03 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.05 SCHEDULE - SEE DRAWINGS

END OF SECTION

SECTION 08 14 23
LAMINATED PLASTIC FACED WOOD DOORS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 081113 - Hollow Metal Doors and Frames.
- B. Section 087100 - Door Hardware.
- C. Section 088000 - Glazing.

1.02 REFERENCE STANDARDS

- A. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- B. ASTM E1408 - Standard Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems; 1991 (Reapproved 2000).
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.
- D. ICC (IBC) - International Building Code; 2012.
- E. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- F. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.
- G. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- H. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Clearly describe full compliance with the requirements of the Section, including quality of door construction, core material, face cladding, fire ratings and installation instructions.
- C. Submit identification of the labeling agency and the labeling agency's approved labeling procedures for door construction, including installation of astragals if applicable.
- D. Submit manufacturer's certification that doors meet or exceed specified fire rating requirements.
- E. Shop Drawings: Show the following minimum information. Use the same reference numbers for openings as those indicated on the Drawings. Shop fabrication work tickets are not acceptable submittals.
 - 1. Door elevations with dimensions.
 - 2. Hand and swing.
 - 3. Fire ratings.
 - 4. Stile and rail construction and reinforcement, mortises and internal blocking for hardware in non-rated and fire-rated doors, and positive pressure provisions for fire-rated doors.
 - 5. Location and type of provisions in doors for scheduled hardware attachment.
 - 6. Thickness and type of laminated plastic cladding and crossbands.
 - 7. Type of finish for all door edges.
 - 8. Locations and dimensions of cut-outs, holes and mortises.
 - 9. Type of glazing stops.
 - 10. Doors with thresholds, undercut bottom edges and other special features.
- F. Specimen warranty.
- G. Test Reports: Show compliance with specified requirements for the following:
 - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
- H. Warranty, executed in Owner's name.

1.04 REQUIREMENTS FOR RATED OPENINGS

- A. Comply with requirements of the code having jurisdiction for fire rated doors for the rating class indicated.
- B. Ensure metal labels, bearing the name of the labeling agency, are shipped on rated doors, placed between the two upper hinge locations. Paper or plastic labels are not acceptable.
- C. Doors shipped without factory affixed labels will be rejected.
- D. Ensure that astragals are shipped on rated doors if the manufacturer's approved labeling procedures require factory installation.
- E. Provide stairway doors to meet 450 degrees F Rise Class criteria minimum.
- F. Provide with internal positive pressure strips.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver items to the site and handle, store and protect under provisions of Section 016000.
- B. Have doors individually packaged at the factory sealed with heat shrunk plastic, and marked on the top and bottom rails for individual door openings indicated on the Drawings.
- C. Deliver doors after the building is enclosed, dry, heated and adequately ventilated. Do not receive or store doors in damp areas. Do not drag the doors on the ground, floor or across one another.
- D. Store doors flat on a level surface. Do not lean doors against vertical surfaces. Break sealed plastic packaging to permit ventilation. Do not subject doors to extreme conditions or changes in heat, dryness or humidity (humidity to be no less than 30% and no more than 60%).
- E. Do not lean doors against vertical surfaces or store doors on edge. Do not store other materials on top of stacked doors. Do not walk on stacked doors.
- F. Handle doors with clean gloves. Do not drag doors across one another or across other surfaces.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Warranty: Replace, including rehanging and refinishing, at no cost to the Owner, doors exhibiting defects in materials and workmanship, including warp (bow, cup, or twist) or delamination, the life of the installation.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Doors - General: "Perma-Clad" laminated plastic clad doors by VT Industries, Inc. (vtindustries.com) as specified below for the application:
 - 1. Particleboard Cores: Particleboard (FSC certified Particleboard), ANSI A208.1, grade 1-LD-2, with the following percentage of door construction weight, composed of pre-consumer recycled material:
 - a. Lead lined doors: 40%.
 - b. Other doors: 70%.
 - 2. Mineral Board Cores: Noncombustible mineral board, 30.8-34.7 lbs/ft³, containing no asbestos: 70%.
 - 3. Sound Attenuation Cores: Multi-ply composite sound core standard with the manufacturer.
 - 4. Crossbanding: Rotary cut, single ply, clear grade hardwood, 1/16 inch thick before sanding.
 - 5. Laminated Plastic: NEMA LD3, Type 1 general purpose, 1/16 inch thick.
 - 6. Stiles and Rails: Suitable for hanging on full mortise butt hinges. "Firestop" stiles and rails will not be acceptable for rated doors.
 - a. Non-Rated, 20-Minute and 45-Minute Doors: Structural composite lumber (SCL).
 - b. 60 and 90 Minute Label Doors: Reinforced "Triple-Ply" stile for suitable hanging on full mortise butt hinges.

- c. All Label Doors: Include internal intumescent strip on stiles and top rail to meet positive pressure requirements.
- 7. Edge Bands: Laminated plastic matching faces for stiles. If tops of any doors are visible, also band the top rail.
- 8. Lite Moldings: Moldings wide enough to completely cover exposed edges of veneer and crossbanding when seated against the glass pane.
 - a. Non-Rated Doors: "VT1" flush rectangular poplar beads, unless noted otherwise.
 - b. Acoustical Doors: No. 105 Acoustical Lite Kit.
 - c. Rated Doors: "VT1F" veneer wrapped moldings, using poplar veneer unless noted otherwise. Other veneer wrapped or solid wood moldings approved in the manufacturer's labeling procedures will be considered. Include concealed metal glazing clips where required by the manufacturer's labeling procedures.
- B. Non-Rated Doors:
 - 1. Lead Lined Doors: No. 1515-3.
 - 2. Acoustical Core Doors: No. 1050H, STC 45.
 - 3. Other Doors: No. 404-3 with laminated particleboard core of 28-30 lbs/cu ft density.
- C. Rated Doors:
 - 1. 20-minute Label Doors - non lead-lined: No. 4P04-3.
 - 2. 20-minute Label Doors - lead lined: No. 1P15-3.
 - 3. 20-minute Acoustical Core Doors: No. 1P50H, STC 45.
 - 4. 45 minute Label Doors: No. 1P45-3 with stiles for using mortise hinges, and meeting U.L. 250 deg F temperature rise criteria.
 - 5. 60 and 90 Minute Label Doors: No. 1P11-3 with stiles for using mortise hinges, and meeting U.L. 250 deg F temperature rise criteria.
- D. All Doors: See drawings for locations and additional requirements.
 - 1. Quality Level: Premium Grade, in accordance with AWI/AWMAC/WI Architectural Woodwork Standards.
 - 2. High Pressure Decorative Laminate Faced Doors: 5-ply unless otherwise indicated.
- E. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at all locations.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with International Building Code ("positive pressure"); UL or WH (ITS) labeled without any visible seals when door is open.
 - 3. Smoke and Draft Control Doors 3.0 cfm per sq ft of door opening at 0.10 inch w.g. pressure at both ambient and elevated temperatures; with "S" label; gasketing is specified in Section 087100.
 - 4. Sound Retardant Doors: Minimum STC of 45, calculated in accordance with ASTM E413, tested in accordance with ASTM E1408.
 - 5. Lead Lined Doors: Minimum 1/16 inch thick, 4 pound lead unless otherwise indicated.
 - 6. High Pressure Decorative Laminate Finish where indicated on drawings.

2.02 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated above.
- B. Fire Rated Doors: Mineral core, Type FD, plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
- C. Sound Retardant Doors: Equivalent to Type PC construction with core as required to achieve rating specified; plies and faces as indicated above.
- D. Lead Lined Doors: Equivalent to Type bonded particleboard core (PC) with continuous lead sheet from edge to edge in the center of the core or between the crossband and the core; lead thickness, plies, and faces as indicated above.

2.03 DOOR FACINGS

- A. High Pressure Decorative Laminate Facing for Fire Doors: NEMA LD 3, SGF; color(s) as indicated; high gloss finish.
- B. High Pressure Decorative Laminate Facing for Non-Fire-Rated Doors: NEMA LD 3, HGS; color(s) as indicated; high gloss finish.
- C. Cross Banding Behind High Pressure Laminate Finish: 1 ply; of Rotary cut, single ply, clear grade hardwood, 1/16 inch thick before sanding.
- D. Facing Adhesive: Type I - waterproof.

2.04 FABRICATION

- A. Fabricate doors to have faces, crossbanding, stiles and cores to match the specified manufacturer's construction for applicable type of doors. For all labeled doors, include internal intumescent strip to meet positive pressure label requirements.
- B. Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
- C. Construction: 5 ply with stiles and rails are bonded to core, then entire unit abrasive planed before crossbanding and veneering. Lead-lined doors similar, but with a ply of lead lining on each side of core.
- D. Cores: Particleboard for non-rated and 20-minute doors, and mineral core for all doors with a fire rating of greater than 20 minutes.
- E. Blocking: Provide wood blocking as needed to eliminate through-bolting hardware, but no less than the following:
 - 1. Doors Indicated to Have Closers: 5-inch top-rail blocking.
 - 2. Doors Indicated to Have Exit Devices: 5-inch mid-rail blocking.
- F. Edge Bands: Apply to conceal crossbanding, Intumescent strips and lead lining, applicable, as well as the transition from the face laminate to the edge band.
- G. Bevel strike and hinge stiles 1/8 inch in 2 inches
- H. Astragals:
 - 1. Lead-Lined Pairs of Doors: Provide leaded aluminum or steel astragals for all pairs of lead-lined doors. Where doors are rated, provide astragals complying with the manufacturer's approved labeling procedures for the rating class indicated.
 - 2. Double Egress Doors in Smoke Partitions: Provide astragals arranged to meet requirements of NFPA 101 with the minimum allowed overlap.
 - 3. Other Labeled Pairs of Doors: Provide astragals complying with the manufacturer's approved labeling procedures for the rating class indicated.
 - 4. Finish: Exposed surfaces to be clear anodized if aluminum, and factory primed if steel.
- I. Make cut-outs for vision panels at the factory to be of sizes and locations indicated. Allow 6 inches minimum at door edge. Have rated doors with vision panels factory glazed with fire rated glass specified in Section 088000 and with veneered glazing beads also installed at the factory. Other doors may also be factory glazed - Contractor's option. Miter stops to form hairline joints.
- J. Hardware Preparation: Make cut-outs at the factory from the hardware manufacturer's templates and approved shop drawings. Pilot drill holes for hardware attachment. Pre-machine doors within industry tolerances, and within the following:
 - 1. Lock Front Preparation Cutouts: +1/32 to -1/64 inch.
 - 2. Other Hardware Locations: +1/32 inch.
- K. Prefitting: Factory prefit doors for frame opening dimensions identified on shop drawings. Perform any necessary factory trimming before any face or edge laminates are applied. For labeled doors, perform trimming in accordance with labeling procedures. Fit doors for the following clearances:
 - 1. Heads and Jambs: 1/8 inch.
 - 2. Floor Clearance - openings with carpet divider: 1/4 inch.

- 3. Floor Clearance - all other openings: 1/2 inch maximum.
- L. Seal top and bottom rails of doors and wood particleboard exposed by cut-outs with high quality preservative
- M. Affix metal fire rating labels and metal STC labels to door the the factory.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes and tolerances are acceptable.
- B. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.
- C. Do not attempt to trim doors on site. Return doors to the manufacturer, or a facility designated by the manufacturer, to have trimming done in accordance with the manufacturer's standard procedures, and in accordance with the manufacturer's approved labeling procedures if doors are rated. Ensure labels, and astragals if required, are installed on rated doors when the doors are returned to the Project site. Replace doors if:
 - 1. After trimming operations, evidence of trimming exists.
 - 2. Trimming operations will require new machining for lockset/latchset placement.
 - 3. Trimming cannot be performed within the guidelines and requirements of the manufacturer's approved labeling procedures.
 - 4. Doors are returned to the site without affixed labels.
 - 5. Doors are returned to the site without affixed astragals if required to be factory installed per the manufacturer's approved labeling procedures.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard. Pilot drill holes for hardware attachment.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Coordinate installation with installation of frames specified in Section 081113 and hardware specified in Section 087100.
- D. If vision lites for non-rated doors are not factory installed, coordinate installation of vision lites. Install veneered stops with corners mitered to form hairline joints.
- E. Installation tolerances:
 - 1. Maximum Diagonal Distortion (Warp): 1/16 inch measured with a straight edge or taught string, corner to corner.
 - 2. Maximum Vertical Distortion (Bow): 1/16 inch measured with a straight edge or taught string, top to bottom.
 - 3. Maximum Width Distortion (Cup): 1/16 inch measured with a straight edge or taught string, edge to edge.
- F. Replace doors which are damaged during installation, or as a result of subsequent construction activities.

3.03 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Ensure doors are free from:
 - 1. Hinge bound conditions, striking or binding.
 - 2. Rattling when in closed position.
- C. If any doors cannot be adjusted to specified conditions, replace such doors and install to meet specified conditions.
- D. If any doors are damaged during attempts at adjustment, replace such doors and install to meet specified conditions.

END OF SECTION

SECTION 08 31 00
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall and ceiling access door and frame units.

1.02 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; current edition.
- B. UL (FRD) - Fire Resistance Directory; current edition.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Project Record Documents: Record actual locations of each access unit.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units:
 - 1. Material: Steel.
 - 2. Size: 12 inch by 12 inch.
 - 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 4. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
- B. Fire-Rated Wall-Mounted Units:
 - 1. Wall Fire-Rating: As indicated on drawings.
 - 2. Material: Steel.
 - 3. Size: 12 inch by 12 inch.
- C. Ceiling-Mounted Units:
 - 1. Material: Steel.
 - 2. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
 - 3. Size - Other Ceilings: 12 inch by 12 inch.
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.02 WALL AND CEILING MOUNTED UNITS

- A. Manufacturers:
 - 1. ACUDOR Products Inc: www.acudor.com/#sle.
 - 2. Babcock-Davis: www.babcockdavis.com/#sle.
 - 3. Cendrex, Inc: www.cendrex.com/#sle.
 - 4. Karp Associates, Inc: www.karpinc.com/#sle.
 - 5. Milcor, Inc: www.milcorinc.com/#sle.
 - 6. Nystrom, Inc: www.nystrom.com/#sle.
- B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 - 1. Style: Exposed frame with door surface flush with frame surface.
 - 2. Door Style: Single thickness with rolled or turned in edges.
 - 3. Frames: 16 gage, 0.0598 inch, minimum thickness.
 - 4. Insulation: Non-combustible mineral wool or glass fiber.
 - 5. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.

6. Steel Finish: Primed.
7. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.
8. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 42 29
AUTOMATIC ENTRANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged power-operated door assemblies of following types:
 - 1. Sliding type.
- B. Controllers, actuators and safety devices.
- C. Maintenance.

1.02 RELATED REQUIREMENTS

- A. Section 28 10 00 - Access Control: Connection to access control system; access control devices used as actuators.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. BHMA A156.10 - American National Standard for Power Operated Pedestrian Doors; 2011.
- C. ITS (DIR) - Directory of Listed Products; current edition.
- D. NFPA 101 - Life Safety Code; 2015.
- E. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
 - 2. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.
- C. Product Data: Provide data on system components, sizes, features, and finishes.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and manufacturer's hardware and component templates.
- E. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- F. Maintenance Data: Include manufacturer's parts list and maintenance instructions for each type of hardware and operating component.
- G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Wrenches and other tools required for maintenance of equipment.

1.05 QUALITY ASSURANCE

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sliding Automatic Entrance Door Assemblies:
 - 1. ASSA ABLOY Entrance Solutions; Besam SL500: www.besam-usa.com/#sle.

2. Horton Automatics: www.hortondoors.com/#sle.
3. NABCO Entrances Inc; GT 1175 Whisper Slider: www.nabcoentrances.com/#sle.
4. Stanley Access Technologies; Dura-Glide 2000 Sliding: www.stanleyaccess.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 POWER OPERATED DOORS

- A. Power Operated Doors: Provide products that comply with NFPA 101 and requirements of authorities having jurisdiction; provide equipment selected for actual door weight and for light pedestrian traffic, unless otherwise indicated.
 1. Sliding and Folding Door Operators: In the event of power failure, provide for manual open, close, and break-away operation of door leaves.
 2. Packaged Door Assemblies: Provide components by single manufacturer, factory-assembled, including doors, frames, operators, actuators, and safeties.
 - a. Finish exposed equipment components to match door and frame finish.
- B. Sliding and Folding Doors with Full Power Operators: Comply with BHMA A156.10; safeties required; provide break-away operation unless otherwise indicated; in the event of break-away operation, interrupt power operation.
 1. Comply with UL 325; acceptable evidence of compliance includes UL (DIR) or ITS (DIR) listing or test report by testing agency acceptable to authorities having jurisdiction.
 2. Force Required to Swing Break-Away Panel: 50 pound-force, maximum, measured at 1 inch from the latch edge of the door at any point in the closing cycle.

2.03 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

- A. Comply with ADA Standards for egress requirements.
- B. Framing and Transom Members: Provide manufacturer's standard extruded aluminum framing, reinforced as required to support imposed loads.
 1. Nominal Sizes:
 - a. Single Slide and Bi-Parting Sliding Doors: 1-3/4 inch wide by 4-1/2 inch deep.
 2. Concealed Fastening: Provide concealed fastening pocket in framing, with continuous flush insert cover extending full length of each framing member.
 3. Transoms: Provide flush glazed transom with framing that is integral with automatic entrance framing system.
- C. Door and Sidelight Construction: Heavy duty interlocked extruded aluminum tubular stile and rail sections, through-rod bolted construction with steel corner support at hinge stile of carrier-suspended swinging panels or mechanically fastened corners with welded reinforcing brackets to reduce sag in sliding or breakout mode.
 1. Door Thickness: 1-3/4 inch, nominal.
 2. Stile Design:
 - a. Medium stile, 3-1/2 inch, nominal width.
 3. Top Rail Height: 4 inch, nominal.
 4. Center Rail (Muntin Bar) Height: 2 inch, nominal.
 5. Bottom Rail Height: 10 inch, nominal.
 6. Glazing Stops: Manufacturer's standard snap-on extruded aluminum square stops with preformed resilient glazing gaskets.
 7. Glazing Stop Width: Manufacturers standard.
 8. Glazing Thickness: 1 inch.
- D. Sliding Automatic Door: Single leaf track-mounted, electric operation, extruded aluminum glazed door, with frame, and operator concealed overhead.
 1. Operation: Power open, power boost operation.
 2. Exterior-Side Actuator/Safety: Motion sensor.
 3. Interior-Side Actuator/Safety: Motion sensor.
 4. Hold Open: Toggle switch at inside head of doors; this is not a fire-rated door.
 5. Door and Frame Finish: Same as adjacent framing system.
 6. Door shall be lockable against ingress after-hours. Free egress at all times.

2.04 CONTROLLERS, ACTUATORS, AND SAFETIES

- A. Controller: Provide microprocessor operated controller for each door.
- B. Comply with BHMA A156.10 for actuator and safety types and zones.
- C. Proximity Detector Actuator/Safety: Microwave; distance of control sensitivity adjustable.
- D. Push Plate Actuator: Standard wall mounted, surface mounted momentary contact type; satin stainless steel plate; 8 inches diameter; labeled PUSH.
- E. Photo-Electric Actuator/Safety: Horizontal single ray device, with aluminum housing for light source and relay units.
- F. Card Reader interface from the exterior for after hours access.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available and is of the correct characteristics.

3.02 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions.
- B. Provide for thermal expansion and contraction of door and frame units and live and dead loads that may be transmitted to operating equipment.
- C. Provide for dimensional distortion of components during operation.
- D. Coordinate installation of components with related and adjacent work; level and plumb.

3.03 ADJUSTING

- A. Adjust door equipment for correct function and smooth operation.

3.04 CLEANING

- A. Remove temporary protection, clean exposed surfaces.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.06 MAINTENANCE

- A. Provide service and maintenance of operating equipment for one year from Date of Substantial Completion, at no extra charge to Owner.

END OF SECTION

SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.

1.02 RELATED REQUIREMENTS

- A. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; 2009.
- C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- E. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- F. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- G. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- H. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- K. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- M. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Missouri.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Aluminum-Framed Storefront and Doors:
 - 1. EFCO Corporation: www.efcocorp.com/#sle.
 - 2. Kawneer North America: www.kawneer.com/#sle.
 - 3. Oldcastle BuildingEnvelope: www.oldcastlebe.com/#sle.
 - 4. Pittco Architectural Metals Inc: www.pittcometals.com/#sle.
 - 5. Tubelite, Inc: www.tubeliteinc.com/#sle.
 - 6. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
 - 7. YKK AP America Inc: www.ykkap.com/#sle.
 - 8. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Rabbet: For 1 inch insulating glazing.
 - 2. Glazing Position: Front-set.
 - 3. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
 - 4. Finish: High performance organic coatings.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - 5. Finish Color: As selected by Architect from manufacturer's standard line.
 - 6. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 7. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 8. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

9. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 10. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 12. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
- B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of ASCE 7.
 - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
 3. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
 4. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
 5. Overall U-value Including Glazing: 0.29 Btu/(hr sq ft deg F), maximum.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Flush.
- B. Glazing: As specified in Section 08 80 00.
- C. Infill Panels: Insulated, aluminum sheet face and back, with edges formed to fit glazing channel and sealed.
1. Core: Rigid polyurethane insulation core with R-value of 21.
 2. Finish: Same as storefront.
- D. Sun Screens: Shop fabricated, shop finished, extruded aluminum outriggers, louvers, and fascia, free of defects impairing strength, durability or appearance.
1. Configuration: As indicated on drawings.
 2. Louver Type: Circular.
 3. Outrigger Shape: Straight.
 4. Design Criteria: Design and fabricate to resist the same loads as storefront system as well as the following loads without failure, damage, or permanent deflection:
 - a. Live: 20 psf; minimum.
 - b. Thermal Movement: Plus/minus 1/8 inch, maximum.
 5. Sizes: As indicated on drawings.
 6. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Fasteners: Stainless steel.

- D. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.
- E. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- F. Sealant for Setting Thresholds: Non-curing butyl type.
- G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.05 FINISHES

- A. Superior Performing Organic Coatings: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride (PVDF) system.
 - 1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness of 0.9 mil; color and gloss as selected from manufacturer's standard line.
- B. Color: As selected by Architect from manufacturer's standard range.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Install glass and infill panels in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
- B. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.

1. Perform a minimum of two tests in each designated area as indicated on drawings.
 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
- C. Repair or replace storefront components that have failed designated field testing, and retest to verify performance conforms to specified requirements.

3.05 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.06 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following:
 - 1. Hinges
 - 2. Continuous hinges
 - 3. Pivots
 - 4. Key control system
 - 5. Lock cylinders and keys
 - 6. Lock and latch sets
 - 7. Bolts
 - 8. Exit devices
 - 9. Closers
 - 10. Overhead stops and holders
 - 11. Miscellaneous door control devices
 - 12. Door trim units
 - 13. Protection plates
 - 14. Weatherstripping for exterior doors
 - 15. Sound and smoke seals for interior doors
 - 16. Automatic drop seals (door bottoms)
 - 17. Astragals or meeting seals on pairs of doors
 - 18. Thresholds
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 01 20 00: Price and Payment Procedures
 - 2. Section 08 11 13: Hollow Metal Doors and Frames
 - 3. Section 08 14 23: Laminated Plastic Faced Wood Doors
 - 4. Section 08 33 23: Overhead Coiling Doors
 - 5. Section 08 71 13: Automatic Door Operators
 - 6. Division 26: Electrical
 - 7. Division 28: Electronic Safety and Security

D. Products furnished but not installed under this Section to include:

1. Cylinders for locks on entrance doors.

1.3 REFERENCES

A. Standards of the following as referenced:

1. American National Standards Institute (ANSI)
2. Door and Hardware Institute (DHI)
3. Factory Mutual (FM)
4. National Fire Protection Association (NFPA)
5. Underwriters' Laboratories, Inc. (UL)
 - a. UL 10C - Fire Tests Door Assemblies

6. Warnock Hersey

B. Regulatory standards of the following as referenced:

1. Department of Justice, Office of the Attorney General, *Americans with Disabilities Act*, Public Law 101-336 (ADA).
2. CABO/ANSI A117.1: Providing Accessibility and Usability for Physically Handicapped People, 2010 edition.

1.4 SYSTEM DESCRIPTION

- A. Refer to applicable "HW SETS" for system description for electric and electro-pneumatic hardware products.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements. For items other than those scheduled in the "Headings" of Section 3, provide catalog information for the specified items and for those submitted.
- C. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into vertical format "hardware sets" indicating complete designations of every item required

for each door or opening. Use specification HW SET numbers with any variations suffixed a, b, etc. Include the following information:

- a. Type, style, function, size, and finish of each hardware item.
 - b. Name and manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of each hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.
 - e. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for hardware.
 - g. Door and frame sizes and materials.
 - h. Keying information.
 - i. Cross-reference numbers used within schedule deviating from those specified.
 - 1) Column 1: State specified item and manufacturer.
 - 2) Column 2: State prior approved substituted item and its manufacturer.
2. Furnish complete wiring diagrams, riser diagrams, elevation drawings, and operational descriptions of electrical components and systems, listed by opening in the hardware submittals. Elevation drawings to identify locations of the system components with respect to their placement in the door opening. Operational descriptions to fully detail how each electrical component will function within the opening, including all conditions of ingress and egress. Provide a copy with each hardware schedule submitted for approval. Supply a copy with delivery of hardware to the jobsite and another copy to the Owner at the time of project completion.
 3. Submittal Sequence: Submit final schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule.
 4. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- D. Provide samples, if requested, of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Submit samples prior to submission of final hardware schedule.
1. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated in the Work, within limitations of keying coordination requirements.
- E. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- F. Contract closeout submittals:
1. Operation and maintenance data: Complete information for installed door hardware.
 2. Warranty: Completed and executed warranty forms.

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware distributor, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced Architectural Hardware Consultant (AHC) who is available for consultation to Owner, Architect, and Contractor, at reasonable times during the course of the Work.
- C. Coordination Meetings:
 - 1. Organize and attend the following:
 - a. Lock distributor to meet with the Owner to finalize lock functions and keying requirements and to obtain final instructions in writing.
 - b. Lock distributor and lock, closer and exit device manufacturers' representative(s) to meet with the installer prior to commencing installation of door hardware. Instruct installer on proper installation of scheduled products.
 - 2. Organize and attend the following:
 - a. Meet with the Owner, hardware supplier, frame and door supplier, electrical sub-contractor and security sub-contractor to coordinate all electrical hardware items. Hardware supplier to provide riser diagrams, elevation drawings, wiring diagrams, and operational descriptions as required by the General and sub-contractors.
- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges, and seals whether listed in the Hardware Schedule or not. All hardware to comply with State and local codes and UL 10C.
 - 2. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".
- E. All hardware is to comply with Federal and State Handicap laws. Provide tactile warning at the back of all outside levers to electrical, mechanical, machine rooms, and doors that lead to hazardous areas.

1.7 PRODUCT HANDLING

- A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.

- B. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- C. Deliver individually packaged door hardware items promptly to place of installation.
- D. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.8 WARRANTY

- A. Special warranties:
 - 1. Surface Door Closers: Thirty (30) year period
 - 2. Exit Devices: Three (3) year period
 - 3. Automatic Door Operators: Two (2) year period
 - 4. Mortise Locks and Cylinders: Three (3) year period

1.9 MAINTENANCE

- B. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

(*Denotes manufacturer referenced in the Hardware Headings)

- A. Hinges:
 - 1. Acceptable manufacturers:
 - a. Ives*
 - 2. Characteristics:
 - a. Templates: Provide only template-produced units.
 - b. Screws: Provide Phillips flat-head screws complying with the following requirements:
 - 1) For metal doors and frames install machine screws into drilled and tapped holes.
 - 2) For wood doors and frames install threaded-to-the-head wood screws.

- 3) For fire-rated wood doors install #12 x 1-1/4", threaded-to-the-head steel wood screws.
- 4) Finish screw heads to match surface of hinges or pivots.
- c. Hinge pins: Except as otherwise indicated, provide hinge pins as follows:
 - 1) Out-Swing Exterior Doors: Non-removable pins.
 - 2) Interior Doors: Non-rising pins.
 - 3) Tips: Flat button and matching plug. Finished to match leafs.
- d. Size: Size hinges in accordance with specified manufacturer's published recommendations.
- e. Quantity: Furnish one pair of hinges for all doors up to 5'-0" high. Furnish one hinge for each additional 2-1/2 feet or fraction thereof.

B. Continuous Hinges:

- 1. Acceptable manufacturers:
 - a. Ives*
- 2. Characteristics:
 - a. Continuous gear hinges to be manufactured of extruded 6063-T6 aluminum alloy with anodized finish, or factory painted finish as scheduled.
 - b. All hinges are to be manufactured to template. Uncut hinges to be non-handed and to be a pinless assembly of three interlocking extrusions applied to the full height of the door and frame without mortising.
 - c. Vertical door loads to be carried on chemically lubricated polyacetal thrust bearings. The door and frame leaves to be continually geared together for the entire hinge length and secured with a full cover channel. Hinge to operate to a full 180°.
 - d. Hinges to be milled, anodized, and assembled in matching pairs. Fasteners supplied to be steel self-drilling, self-tapping 12-24 x 3/4".
 - e. Provide UL listed continuous hinges at fire doors. Continuous hinges at fire doors to meet the required ratings without the use of auxiliary fused pins or studs.

C. Pivot Sets:

- 1. Acceptable manufacturers:
 - a. Ives*
- 2. Characteristics:
 - a. Pivots to be high strength forged bronze with top pivot housing with spring activated bronze retracting pin. Pivots to have tilt-on bearing and bearing pin.
 - b. Offset and intermediate pivots to be handed at the factory. Pivot set to support doors to 1750 pounds. Each intermediate pivot to support 100 additional pounds. Centerline of pivots to be 3/4" from face of door, 3/4" from edge of door.

D. Cylinders:

1. Acceptable manufacturers:
 - a. Match Existing key system
2. Characteristics:
 - a. Key permanent cores into the existing key system. Hardware sets included Schlage cylinders as basis of design. Cylinder requirements must be verified with owner.
 - b. Equip locksets with interchangeable core cylinders unless not included in existing system, and keyed construction cores.
 - c. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.
 - d. Comply with Owner's instructions for master keying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.
 - 1) Permanently inscribe each key with number of lock that identifies cylinder manufacturer's key symbol, and notation, "DO NOT DUPLICATE".
 - e. Key Material: Provide keys of nickel silver only.
 - f. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, 5 grandmaster keys for each grandmaster system, 5 construction master keys, and 5 control keys for interchangeable core series.
 - 1) Furnish one extra blank for each lock.
 - 2) Furnish construction master keys to General Contractor.
 - 3) Deliver keys to Owner.

E. Locksets, Latchsets, Deadbolts:

1. Acceptable manufacturers:
 - a. Schlage*
2. Mortise Locksets and Latchsets: as scheduled.
 - a. Chassis: Cold-rolled steel, handing field-changeable without disassembly.
 - b. Latchbolts: 3/4" throw stainless steel anti-friction type.
 - c. Lever Trim: Through-bolted, accessible design, cast or solid rod lever as scheduled. Spindles: Independent break-away.
 - d. Thumbturns: Accessible design not requiring pinching or twisting motions to operate.
 - e. Deadbolts: Stainless steel 1" throw.
 - f. Electric operation: Manufacturer-installed continuous duty solenoid.
 - g. Strikes: 16 gage curved stainless steel, bronze, or brass with 1" deep box construction, lips of sufficient length to clear trim and protect clothing.
 - h. Scheduled Lock Series and Design: Schlage L series.

- i. Certifications:
 - 1) ANSI A156.13, 1994, Grade 1 Operational, Grade 1 Security.
 - 2) ANSI/ASTM F476-84 Grade 30 UL Listed.
 - 3. Extra Heavy Duty Cylindrical Locks and Latches: as scheduled, fastened with through-bolts.
 - a. Chassis: Cylindrical design, corrosion-resistant plated cold-rolled steel.
 - b. Locking Spindle: Stainless steel, interlocking design.
 - c. Latch Retractors: Forged steel. Balance of inner parts: Corrosion-resistant plated steel, or stainless steel.
 - d. Lever Trim: Accessible design, independent operation, spring-cage supported, minimum 2" clearance from lever mid-point to door face.
 - e. Rosettes: Minimum 3-7/16" diameter for coverage of ANSI/DHI A115.18, 1994 door preparation, through-bolt lugs on both spring cages to fully engage this pattern.
 - f. Springs: Full compression type.
 - g. Electric operation: Manufacturer-installed continuous duty solenoid.
 - h. Strikes: 16 gage curved steel, bronze, or brass with 1" deep box construction, lips of sufficient length to clear trim and protect clothing.
 - i. Lock Series and Design: Schlage ND series.
 - j. Certifications:
 - 1) ANSI A156.2, 1994, Series 4000, Grade 1. Tested to exceed 3,000,000 cycles.
 - 2) UL listed for A label single doors up to 4 ft x 8 ft.
 - 4. Deadbolts: as scheduled. Rotating cylinder trim rings of attack-resistant design. Mounting plates and actuator shields of plated cold-rolled steel. Mounting screws of 1/4" dia. steel and protected by drill-resistant ball bearings. Steel alloy deadbolt with hardened steel roller. Strike with 1/8" thick strike reinforcer and two 3" long screws. ANSI A156.5, 1992 Grade 1 certified.
- F. Exit Devices:
- 1. Acceptable manufacturers:
 - a. Von Duprin*
 - 2. Characteristics:
 - a. Exit devices to be "UL" listed for life safety. All exit devices for fire rated openings to have "UL" labels for "Fire Exit Hardware".
 - b. All exit devices mounted on labeled wood doors to be mounted on the door in accordance with the door manufacturer's requirements.
 - c. All trim to be thru-bolted to the lock stile case. Lever design to match locksets.
 - d. All exit devices to be made of brass, bronze, stainless steel, or aluminum material, powder coated, anodized, or plated to the standard architectural finishes to match the balance of the door hardware.

- e. Provide glass bead conversion kits to shim exit devices on doors with raised glass beads.
- f. All exit devices to be one manufacturer. No deviation will be considered.
- g. All series exit devices to incorporate a fluid damper, which decelerates the touchpad on its return stroke and eliminates noise associated with exit device operation.
- h. All exit devices to be non-handed. Touchpad to extend a minimum of 1/2 of the door width and extend to the height of the cross rail housing for a “no pinch” operation. Plastic touchpads are not acceptable.
- i. All latchbolts to be the deadlocking type. Latchbolts to have a self-lubricating coating to reduce wear. Plated or plastic coated latchbolts are not acceptable. Plastic linkage and “dogging” components are not acceptable.
- j. Lever trim to be solid case material with a break-away feature to limit damage to the unit from vandalism. The break-away feature to utilize a clutch mechanism allowing the lever to drop to the six o'clock position and reset manually.
- k. Surface vertical rod devices to be UL labeled for fire door applications without the use of bottom rod assemblies. Where bottom rods are required for security applications, the devices to be UL labeled for fire doors applications with rod and latch guards by the device manufacturer.
- l. Exit devices to include impact resistant, flush mounted end cap design to avoid damage due to carts and other heavy objects passing through an opening. End cap to be of heavy-duty metal alloy construction and provide horizontal adjustment to provide alignment with device cover plate. When exit device end cap is installed, no raised edges will protrude.

G. Electric Strikes:

- 1. Acceptable manufacturers:
 - a. Von Duprin*
- 2. Characteristics:
 - a. Heavy duty, stainless steel construction.
 - b. Adjustable strike box to compensate for any misalignment of door or frame.
 - c. Two-piece plug connectors for ease of installation and for removal during strike servicing.

H. Closers and Door Control Devices:

- 1. Acceptable manufacturers:
 - a. LCN Closers*
- 2. Characteristics:
 - a. Door closers to have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder.
 - b. All closers to utilize a stable fluid withstanding temperature range of 120°F to -30°F without seasonal adjustment of closer speed to properly close the door.

Closers for fire-rated doors to be provided with temperature stabilizing fluid that complies with standards UBC 7-2 (1997) and UL 10C.

- c. Spring power to be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Hydraulic regulation to be by tamper-proof, non-critical valves. Closers to have separate adjustment for latch speed, general speed and back check.
- d. All closers to have solid forged steel main arms and, where specified, to have a stop on the closer shoe ("SCUSH"). Where door travel on out-swing doors must be limited, "SCUSH" type closers. Auxiliary stops are not required when "SCUSH" type closers are used. Provide drop plates where top rail of door is not sufficient for closer mounting. Provide "cush shoe supports" and "blade stop spacers" where dictated by frame details.
- e. All closers (overhead, surface, and concealed) to be of one manufacturer and carry manufacturer's ten (10) year warranty. Electric closers to have two year warranty.
- f. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped provide adjustable units complying with ADA and ANSI A-117.1 provisions for door opening force.
- g. Closers to be installed to allow door swing to the maximum degree of opening before striking an obstruction. Doors swinging into exit corridors to provide for corridor clear width as required by code. Where possible, mount closers inside rooms.
- h. Powder coating finish to be certified to exceed 100 hours salt spray testing by ETL, an independent testing laboratory used by BHMA for ANSI certification.
- i. Combination Door Closers and Holders: Provide units designed to hold door in open position under normal usage and to release and automatically close door under fire conditions. Incorporate an integral electromagnetic holder mechanism designed for use with UL listed fire detectors, provided with normally closed switching contacts.
- j. Magnetic Door Holders to be heavy duty wall mounted with metal housing and complete mounting hardware. Provide 24V holding coils unless otherwise scheduled.

I. Overhead Door Stops and Holders:

- 1. Acceptable manufacturers:
 - a. Glynn Johnson*
- 2. Characteristics:
 - a. Provide door stops and holders of brass, bronze or stainless steel.
 - b. Concealed stops and holders to be installed with the jamb bracket mortised flush with the bottom of the jamb. The arm and channel to be mortised into the door.
 - c. Surface-mounted stops and holders to be installed with the jamb bracket mounted on the stop.

J. Floor Stops and Wall Bumpers:

1. Acceptable manufacturers:
 - a. Ives*
2. Characteristics: Refer to Part 3, Hardware Schedule.

K. Door Bolts/Coordinators:

1. Acceptable manufacturers:
 - a. Ives*
 - b. Richards Wilcox* - Cane bolt only
2. Characteristics:
 - a. Flush bolts to be forged brass 6-3/4" x 1", with 1/2" diameter bolts. Plunger to be supplied with milled surface one side that fits into a matching guide.
 - b. Automatic flush bolts to be UL listed as top and bottom bolts on a pair of classified fire doors. Bolt construction to be of rugged steel and brass components.
 - c. Self-latching flush bolts to be UL listed as top and bottom bolts on a pair of classified fire doors. Bolt construction to be of rugged steel and brass components.
 - d. Automatic flush bolts and self-latching flush bolts are to be UL listed for fire door application without bottom bolts.
 - e. Furnish dust proof bottom strikes.
 - f. Coordinator to be soffit mounted non-handed fully automatic UL listed coordinating device for sequential closing of paired doors with or without astragals.
 - g. Provide filler pieced to close the header. Provide brackets as required for mounting of soffit applied hardware.

L. Push Plates:

1. Acceptable manufacturers:
 - a. Ives*
2. Characteristics:
 - a. Exposed Fasteners: Provide manufacturers standard exposed fasteners.
 - b. Material to be stainless steel.
 - c. Provide plates sized as shown in Part 3, Hardware Schedule.

M. Door Pulls & Pull Plates:

1. Acceptable manufacturers:
 - a. Ives*

2. Characteristics:

- a. Provide concealed thru-bolted trim on back to back mounted pulls, but not for single units.
- b. Material to be stainless steel.
- c. Provide units of types and sizes shown in Part 3, Hardware Schedule.

N. Protective Plates:

1. Acceptable manufacturers:

- a. Ives*

2. Characteristics:

- a. Provide manufacturers standard exposed fasteners for door trim units consisting of either machine screws or self-tapping screws.
- b. Materials:
 - 1) Metal Plates: Stainless Steel, .050 inch (U.S. 18 gage).
- c. Fabricate protection plates not more than 2" less than door width on push side and not more than 1" less than door width on pull side.

O. Thresholds:

1. Acceptable manufacturers:

- a. Zero Weatherstripping*

2. Types: Indicated in Part 3, Hardware Schedule.

P. Door Seals/Gasketing:

1. Acceptable manufacturers:

- a. Steelcraft*
- b. Zero Weatherstripping*

2. Types: Indicated in Part 3, Hardware Schedule.

Q. Silencers:

1. Acceptable manufacturers:

- 2. Ives*
- 3. Three (3) for each single door; two (2) for each pair of doors.
- 4. Omit silencers at openings scheduled to receive perimeter gasketing.

R. Key Cabinet and System:

1. Acceptable manufacturers:
 - a. Telkee
2. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150 percent of the number of locks required for the project.
 - a. Provide complete cross index system set up by key control distributor, and place keys on markers and hooks in the cabinet as determined by the final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.
 - c. Provide multiple-drawer type cabinet.

S. Security Equipment:

1. Acceptable manufacturers:
2. Characteristics:
 - a. Provide items as found in Part 3, Hardware Schedule.
3. Coordinate security equipment with electrical systems.

2.2 MATERIALS AND FABRICATION

- A. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.
- B. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 1. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
 2. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
 3. Unless indicated otherwise provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners.

4. Use thru-bolts for installation of all exit devices, closers, and overhead stops. Coordinate with wood doors and metal doors and frames. Where thru-bolts are used, provide sleeves for each thru-bolt as a means of reinforcing the work, or use sex nut and bolt fasteners.

2.3 HARDWARE FINISHES

- A. Match items to the manufacturer's standard color and texture finish for the latch and lock sets (or push-pull units if no latch or lock sets).
- B. Provide finishes that match those established by ANSI or, if none established, match the Architect's sample.
- C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.
- B. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
- C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- D. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Sealers".
- G. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.2 ADJUSTING, CLEANING, AND DEMONSTRATING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
 - 1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to function properly with final operation of heating and ventilating equipment.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Door Hardware Supplier's Field Service:
 - 1. Inspect door hardware items for correct installation and adjustment after complete installation of door hardware.
 - 2. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.
 - 3. File written report of this inspection to Architect.

3.3 HARDWARE SCHEDULE

Hardware Group No. 005E – PUBLIC MULTI-STALL RESTROOM/LOCKERS
 For use on mark/door #(s):

110	111	210	211	310	311
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Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE
1	EA	PULL PLATE	8303 8" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4050 RW/PA	689	LCN
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 005F - MAIL ROOM

For use on mark/door #(s):

105C

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
4	EA	HW HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	PASSAGE SET	ND10S SPA	626	SCH
1	EA	SURFACE CLOSER	4050 SCUSH	689	LCN
1	EA	PA MOUNTING PLATE	4050-18PA	689	LCN
1	EA	GASKETING	188S	S-Br	ZER

Hardware Group No. 006A - HOUSEKEEPING

For use on mark/door #(s):

112 212 312

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
1	EA	CONVENTIONAL CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4050 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188S	S-Br	ZER

Hardware Group No. 006D - TENANT SPACE

For use on mark/door #(s):

105B	108A	108B	202A	202B	202C
207A	302A	302B	302C	307A	

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
1	EA	CONVENTIONAL CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4050 RW/PA	689	LCN
1	EA	WALL STOP	WS406CCV	630	IVE
1	EA	GASKETING	188S	S-Br	ZER

Hardware Group No. 006E - TENANT SPACE

For use on mark/door #(s):

116B 207B 207C 307B 307C

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
1	EA	CONVENTIONAL CORE	23-030	626	SCH
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4050 RW/PA	689	LCN
1	EA	GASKETING	188S	S-Br	ZER

Hardware Group No. 006F - TENANT SPACE

For use on mark/door #(s):

105A 116A

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
1	EA	CONVENTIONAL CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4050 SCUSH	689	LCN
1	EA	PA MOUNTING PLATE	4050-18PA	689	LCN
1	EA	GASKETING	188S	S-Br	ZER

Hardware Group No. 007A - ELECTRICAL / COMM

For use on mark/door #(s):

109 208 209 308 309

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
1	EA	CONVENTIONAL CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4050 RW/PA	689	LCN
1	EA	WALL STOP	WS406CCV	630	IVE
1	EA	GASKETING	188S	S-Br	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER
1	EA	THRESHOLD	AS REQUIRED	CL	ZER

Hardware Group No. 007C - FACILITIES MANAGEMENT

For use on mark/door #(s):

113

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
1	EA	CONVENTIONAL CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4050 RW/PA	689	LCN
1	EA	WALL STOP	WS406CCV	630	IVE
1	EA	GASKETING	188S	S-Br	ZER

Hardware Group No. 010A - STAIRWELL

For use on mark/door #(s):

205

214

305

314

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	98-L-F-17-SNB	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4050 RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS441	626	IVE
1	EA	GASKETING	188S	S-Br	ZER

Hardware Group No. 010D - STAIRWELL W/ CARD READER

For use on mark/door #(s):

106A 117A

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-98-L-F-E996-17-FS-SNB	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4050 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS441	626	IVE
1	EA	GASKETING	188S	S-Br	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION

PRESENTATION OF VALID CREDENTIAL UNLOCKS TRIM. TRIM RE-LOCKS AFTER PRESET INTERVAL. FREE EGRESS AT ALL TIMES. COORDINATE WITH ELECTRICAL, SECURITY AND FIRE LIFE SAFETY SYSTEMS

Hardware Group No. 101B - RISER

For use on mark/door #(s):

114

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM W/DEADBOLT	L9480T 17A L583-363	630	SCH
1	EA	CONVENTIONAL CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4050 SCUSH	689	LCN
1	EA	GASKETING	312A	A	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	65A-MSLA-10 X EBF	A	ZER
1	EA	RAIN DRIP	142A	A	ZER

Hardware Group No. 101D - EXTERIOR STAIRWELL

For use on mark/door #(s):

106B 117B

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 5 X 4.5 NRP	630	IVE
1	EA	FIRE EXIT HARDWARE	98-L-NL-F-17	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4050 SCUSH	689	LCN
1	EA	GASKETING	312A	A	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	65A-MSLA-10 X EBF	A	ZER

Hardware Group No. 102A - EXTERIOR W/CARD READER

For use on mark/door #(s):

107 115

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-9875-NL-L/TRIM	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	90 DEG OFFSET PULL	8190HD 10" O	630	IVE
1	EA	SURFACE CLOSER	4050 SCUSH	689	LCN
1	EA	GASKETING	312A	A	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	65A-MSLA-10 X EBF	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION

PRESENTATION OF VALID CREDENTIAL RETRACTS LATCH BOLT. LATCH BOLT RE-LATCHES AFTER PRESET INTERVAL. RX SWITCH IN PANIC BAR SHUNTS DPS. FREE EGRESS AT ALL TIMES

Hardware Group No. 109A - ALUM SLIDING AUTO OPERATOR AND CARD READER

For use on mark/door #(s):

100A

Provide each SL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	MORTISE CYLINDER	20-062-ICX	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	MULTITECH READER	MT15	BLK	SCE

BALANCE OF HARDWARE BY DOOR SUPPLIER
COORDINATE WITH SECURITY AND ELECTRICAL

Hardware Group No. 110A - VESTIBULE ALUM SLIDING AUTO OPERATOR W/ CARD READER

For use on mark/door #(s):

100B

Provide each SL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	MULTITECH READER	MT15	BLK	SCE

BALANCE OF HARDWARE BY DOOR SUPPLIER
COORDINATE WITH SECURITY AND ELECTRICAL

Hardware Group No. 112A - DUMPSTER ENCLOSURE

For use on mark/door #(s):

002

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CANE BOLT	0524.00023SS	630	RIC

BALANCE OF HARDWARE BY GATE SUPPLIER

Hardware Group No. 900 - ROOF HATCH

For use on mark/door #(s):

401

Provide each SGL door(s) with the following:

ALL HARDWARE BY HATCH MANUFACTURER

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass.
- B. Glazing compounds and accessories.

1.02 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- E. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- F. GANA (GM) - GANA Glazing Manual; 2009.
- G. GANA (SM) - GANA Sealant Manual; 2008.
- H. ICC (IBC) - International Building Code; 2015.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Samples: Submit two samples 12 by 12 inch in size of glass units.
- E. Certificates: Certify that products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and GANA Sealant Manual for glazing installation methods.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.05 MOCK-UP

- A. Provide mock-up of exterior including glass.
- B. Locate where directed by Architect.
- C. Mock-up may not remain as part of the Work.

1.06 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.01 INSULATING GLASS UNITS

2.02 BASIS OF DESIGN - INSULATING GLASS UNITS

- A. Type G-1 - Sealed Insulating Glass Units: Vision glazing, with Low-E coating.
 - 1. Application: All exterior glazing unless otherwise indicated.
 - 2. Between-lite space filled with argon.
 - 3. Thermal Resistance (U-Value): 0.29, nominal.
 - 4. Total Solar Heat Gain Coefficient: 0.27, maximum.
 - 5. Total Visible Light Transmittance: 42 percent, maximum.
 - 6. Basis of Design: PPG.
 - 7. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
 - a. Tint: SolarBronze.
 - 8. Inboard Lite: Fully tempered float glass, 1/4 inch thick.
 - a. Tint: SolarBan60.
 - b. Low-E Coating: #3 surface.
 - 9. Total Thickness: 1 inch.
 - 10. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of another acceptable manufacturer.

2.03 GLAZING UNITS

- A. Type G-2 - Sealed Insulating Glass Units: Spandrel glazing.
 - 1. Application: Exterior glazing where indicated.
 - 2. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
 - a. Tint: Bronze.
 - 3. Inboard Lite: Fully tempered float glass, 1/4 inch thick.
 - a. Tint: Clear.
 - b. Opacifier: Ceramic frit, on #4 surface.
 - 4. Total Thickness: 1 inch.
 - 5. Glazing Method: Gasket glazing.
- B. Sealed Insulating Glass Units: Safety glazing.
 - 1. Application: Provide this type of glazing in the following locations:
 - a. Glazed lites in exterior doors.
 - b. Glazed sidelights and panels next to doors.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on the drawings.
 - 2. Type: Same as other vision glazing except use fully tempered float glass for both outboard and inboard lites.
- C. Single Vision Glazing:
 - 1. Application: All interior glazing unless otherwise indicated.
 - 2. Type: Fully tempered float glass.
 - 3. Tint: Clear.
 - 4. Thickness: 1/4 inch.
- D. Fire-Protection-Rated Glazing:
 - 1. IBC Fire Protection Rating: D-H-T-90, minimum.
 - 2. Safety Certification: 16 CFR 1201 Category II.
 - 3. Application: Provide this type of glazing in the following locations:
 - a. Glazed lites in fire doors.
 - b. Fire windows.
 - c. Sidelights, borrow lites, and other glazed openings in partitions indicated as having an hourly fire rating.
 - 4. Thickness: 1/4 inch.
- E. Decorative Glazing:

1. Application: Locations indicated on the drawings.
2. Type: Etched float glass, fully tempered.
3. Tint: Clear.
4. Thickness: 1/4 inch, nominal.
5. Glazing Method: Interior dry method, tape and tape.

2.04 EXTERIOR GLAZING ASSEMBLIES

- A. Performance Criteria: Select type and thickness of glass to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of glass.
 1. Design Pressure: Calculated in accordance with applicable codes.
 2. Glass thicknesses listed are minimum.
- B. Air and Vapor Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier:
 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
 2. To maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

2.05 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless noted otherwise.
 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
 2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and Kind FT.
 3. Tinted Types: ASTM C1036, Class 2 - Tinted, color and performance characteristics as indicated.
 4. Thicknesses: As indicated; for exterior glazing comply with requirements indicated for wind load design regardless of thickness indicated.
- B. Fire-Protection-Rated Glazing: Type, thickness, and configuration as required to achieve indicated ratings.
 1. IBC Fire Protection Rating: As indicated on drawings.
 2. Provide products listed by Underwriters Laboratories or Intertek Warnock Hersey.
 3. Labeling: Provide permanent label on each piece giving the IBC rating and other information required by the applicable code.
 4. "T-Rated" Products: Where D-H-T-90 or D-H-T-60 rating is indicated, provide one of the following products:
 - a. Technical Glass Products; Pilkington Pyrostop: www.fireglass.com/#sle.
 - b. SAFTI FIRST, a division of O'Keeffe's Inc; SuperLite II-XL: www.safti.com/#sle.
 - c. Vetrotech Saint-Gobain North America; Keralite ULTRA: www.vetrotechusa.com/#sle.

2.06 SEALED INSULATING GLASS UNITS

- A. Sealed Insulating Glass Units: Types as indicated.
 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 2. Edge Spacers: Aluminum, bent and soldered corners.
 3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
 4. Purge interpane space with dry hermetic air.

2.07 GLAZING COMPOUNDS

2.08 GLAZING ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; hardness range of 5 to 30 cured Shore A durometer; coiled on release paper; black color.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; Black color.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.
- D. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.

3.03 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)

- A. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.04 INSTALLATION - INTERIOR DRY METHOD (TAPE AND TAPE)

- A. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- D. Place glazing tape on free perimeter of glazing in same manner described above.
- E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- F. Knife trim protruding tape.

3.05 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

END OF SECTION

SECTION 08 91 00

LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Louvers, frames, and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 23 31 00 - HVAC Ducts and Casings: Ductwork attachment to louvers.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2012.
- C. AMCA 511 - Certified Ratings Program for Air Control Devices; 2010.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.
- D. Test Reports: Independent agency reports showing compliance with specified performance criteria.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
 - 1. Finish: Include twenty year coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 LOUVERS

- A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
 - 1. Wind Load Resistance: Design to resist positive and negative wind load as required by code without damage or permanent deformation.
 - 2. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
 - 3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
 - 4. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.

- B. Stationary Louvers: Horizontal blade, formed galvanized steel sheet construction, with concealed intermediate mullions.
 - 1. Free Area: 50 percent, minimum.
 - 2. Blades: Sightproof with drainable edge design.
 - 3. Frame: 4 inches deep, channel profile; corner joints mitered and, with continuous recessed caulking channel each side.
 - 4. Steel Thickness, Galvanized: Frame 16 gage, 0.0598 inch minimum base metal; blades 16 gage, 0.0598 inch minimum base metal.
 - 5. Steel Finish: Superior performing organic coatings, finished after fabrication.

2.03 MATERIALS

- A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

2.04 FINISHES

- A. Superior Performing Organic Coatings: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system.
 - 1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness of 0.9 mil; color and gloss as indicated on drawings.
- B. Color: As indicated on drawings.

2.05 ACCESSORIES

- A. Blank-Off Panels: Same material as louver, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
- B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.
- C. Bird Screen: Interwoven wire mesh of steel, 14 gage, 0.0641 inch diameter wire, 1/2 inch open weave, diagonal design.
- D. Insect Screen: 18 x 16 size aluminum mesh.
- E. Fasteners and Anchors: Galvanized steel.
- F. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
- G. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Set sill members and sill flashing in continuous bead of sealant.
- D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- E. Secure louver frames in openings with concealed fasteners.
- F. Coordinate with installation of mechanical ductwork.

3.02 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

END OF SECTION

SECTION 09 05 61

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in contract documents that are receiving the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Carpet tile.
 - 3. Thin-set ceramic tile and stone tile.
- B. Preparation of new concrete floor slabs for installation of floor coverings.
- C. Testing of concrete floor slabs for moisture and alkalinity (pH).
- D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

1.02 PRICE AND PAYMENT PROCEDURES

- A. General contractors must direct their subcontractors to ensure they are reaching out to only these manufacturers to obtain pricing and to purchase. Pricing is to be obtained during the bidding phase from mitigation contractor and/or flooring subcontractor, and is to be written into their subcontracts as an add-alternate.
- B. Alternate for Alternate Flooring Adhesive: Do not include the cost of the alternate adhesive in the base bid; state on the bid form the total additional cost for the alternate adhesive, installed, in the event such remediation is required.
- C. Alternate for Remedial Floor Coating or Sheet Membrane: Do not include the cost of floor coating or underlayment in the base bid; state on the bid form the total additional cost for the floor coating, installed, in the event such remediation is required.

1.03 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.

1.04 SUBMITTALS

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- B. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Submit report to Architect.
 - 7. Submit report not more than two business days after conclusion of testing.
- C. Adhesive Bond and Compatibility Test Report.

1.05 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.
- C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- D. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- E. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Utilize Manningtons' recommended adhesive product for each type of flooring for concrete testing up to 90% Relative Humidity (RH). For concrete testing over 90% RH, the use of either Adhesive or Moisture Mitigation, as listed below, will be acceptable for floor prep.
 - 1. Refer to attached recommendation chart by Mannington

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Perform following operations in the order indicated:
 - 1. Preliminary cleaning.
 - 2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 - 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 5. Specified remediation, if required.
 - 6. Patching, smoothing, and leveling, as required.

7. Other preparation specified.
 8. Adhesive bond and compatibility test.
 9. Protection.
- B. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.03 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.04 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
- C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
- D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity

(pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.

- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.05 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

END OF SECTION

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Acoustic insulation.
- E. Gypsum sheathing.
- F. Gypsum wallboard.
- G. Joint treatment and accessories.
- H. Acoustic (sound-dampening) wall and ceiling board.

1.02 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.
- B. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- C. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.

1.03 REFERENCE STANDARDS

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- J. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- K. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- L. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing Board; 2013.
- M. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- N. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2013.
- O. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- P. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.

- Q. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- R. GA-216 - Application and Finishing of Gypsum Board; 2013.
- S. GA-600 - Fire Resistance Design Manual; 2015.
- T. ICC (IBC) - International Building Code; 2015.
- U. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum five years of experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- E. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.
 - 1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
 - 2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
 - 3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com/#sle.
 - 2. Marino: www.marinoware.com/#sle.
 - 3. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.

4. SCAFCO Corporation: www.scafco.com/#sle.
 5. Steel Construction Systems: www.steelconsystems.com/#sle.
 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
1. Studs: "C" shaped with flat or formed webs with knurled faces.
 2. Runners: U shaped, sized to match studs.
 3. Ceiling Channels: C-shaped.
 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
 5. Resilient Furring Channels: 1/2 inch depth, for attachment to substrate through both legs; both legs expanded metal mesh.
 - a. Products:
 - 1) Phillips Manufacturing Co; RC-2 Resilient Sound Channel:
www.phillipsmfg.com/#sle.
- C. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 40 00.
- D. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- F. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
 3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
 4. Deflection and Firestop Track:
 - a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
 - b. Products:
 - 1) FireTrak Corporation; Posi Klip.
 - 2) Metal-Lite, Inc; The System.
 5. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.

2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company: www.americangypsum.com/#sle.
 2. CertainTeed Corporation: www.certainteed.com/#sle.
 3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 4. National Gypsum Company: www.nationalgypsum.com/#sle.
 5. USG Corporation: www.usg.com/#sle.
 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 2. Glass mat faced gypsum panels as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.

- b. Mold resistant board is required in bathrooms.
 - 4. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 5. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 1/2 inch.
 - 6. Mold Resistant Paper Faced Products:
 - a. American Gypsum Company; M-Bloc Type X.
 - b. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard.
 - c. National Gypsum Company; Gold Bond XP Gypsum Board.
 - 7. Glass Mat Faced Products:
 - a. Georgia-Pacific Gypsum; DensArmor Plus.
 - b. Georgia-Pacific Gypsum; DensArmor Plus Fireguard C.
 - c. National Gypsum Company; Gold Bond eXP Interior Extreme Gypsum Panel.
 - d. National Gypsum Company; Gold Bond eXP Fire-Shield Interior Extreme Gypsum Panel.
 - e. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough.
- C. Acoustical Sound Dampening Wall and Ceiling Board: Two layers of heavy paper faced, high density gypsum board separated by a viscoelastic polymer layer and capable of achieving STC rating of 50 or more in typical stud wall assemblies as calculated in accordance with ASTM E413 and when tested in accordance with ASTM E90.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 4. Products:
 - a. National Gypsum Company; Gold Bond SoundBreak XP Gypsum Board: www.nationalgypsum.com/#sle.
- D. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
 - 1. Application: Exterior sheathing, unless otherwise indicated.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 - 4. Core Type: Regular.
 - 5. Regular Board Thickness: 1/2 inch.
 - 6. Edges: Square.
 - 7. Glass Mat Faced Products:
 - a. American Gypsum Company; M-Glass Exterior Sheathing.
 - b. Georgia-Pacific Gypsum; DensGlass Sheathing.
 - c. National Gypsum Company; Gold Bond eXP Sheathing.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
 - 1. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. Products:
 - a. American Gypsum Company; M-Glass Shaft Liner.
 - b. Georgia-Pacific Gypsum; DensGlass Shaftliner (mold-resistant).
 - c. National Gypsum Company; Gold Bond Brand eXP Shaftliner.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 2 inch.

- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Water-Resistive Barrier: As specified in Section 07 25 00.
- D. Moisture Guard Trim: ASTM C1047, rigid plastic, 48 inch length, applied to bottom edge of gypsum board.
 - 1. Height: 1/2 inch.
 - 2. Products:
 - a. Watertguard USA; Watertguard: www.watertguard-usa.com/#sle.
 - 3. Use in all Mechanical rooms
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Tape: 2 inch wide, coated glass fiber tape for joints and corners.
 - 2. Chemical hardening type compound.
- F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- G. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
 - 1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
 - 2. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
 - 1. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/1200.
 - 2. Laterally brace entire suspension system.
 - 3. Install bracing as required at exterior locations to resist wind uplift.
- C. Studs: Space studs at 16 inches on center.
 - 1. Extend partition framing to structure in all locations.
 - 2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Blocking: Install wood blocking for support of:
 - 1. Wall mounted cabinets.
 - 2. Plumbing fixtures.
 - 3. Toilet partitions.
 - 4. Toilet accessories.
 - 5. Wall mounted door hardware.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 - 1. Place one bead continuously on substrate before installation of perimeter framing members.
 - 2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 - 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
 - 1. Seal joints, cut edges, and holes with water-resistant sealant.
 - 2. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.
- E. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- D. Moisture Guard Trim: Install on bottom edge of gypsum board according to manufacturer's instructions and in locations indicated on drawings.

3.07 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 3. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.

3.08 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 30 00

TILING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Furnish labor, materials, tools and other equipment, and services necessary to provide surface preparation and the application of tile work, including all components and accessory items required for a complete installation.
 - 1. Ceramic tile
 - 2. Ceramic mosaic tile
 - 3. Porcelain tile
 - 4. Porcelain mosaic tile
 - 5. Glass tile
 - 6. Glass mosaic tile
 - 7. Quarry tile
 - 8. Thresholds
 - 9. Waterproof membrane
 - 10. Crack-isolation membrane
 - 11. Metal edge strips
- B. Work under this Section also includes moisture and alkalinity testing, and surface preparation of substrates as required for acceptance of tile, including but not necessarily limited to, cleaning, small crack repair, patching, filling, any other work required to provide an appropriate substrate.

1.03 RELATED SECTIONS

- A. Division 03 Section "Cast-In-Place Concrete" for monolithic slab finishes specified for tile substrate.
- B. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control and isolation joints in tile surfaces.
- C. Division 09 Section "Gypsum Board" for glass mat water-resistant gypsum board and cementitious backer boards.
- D. Division 09 Section "Stone Tiling."

1.04 REFERENCE STANDARDS

- A. American National Standards Institute
 - 1. ANSI A108 Series: Specifications for Installation of Ceramic Tile
 - 2. ANSI A118 and A137.1 Series: Specifications for Materials
- B. American Society For Testing Materials (ASTM) International
 - 1. ASTM A 137.1: Test Method for Determining the Dynamic Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the DCOF Acu Test Method .
- C. Tile Council of North America, Inc. (TCNA)
 - 1. Handbook for Ceramic Tile Installation. Latest Edition.
- D. This specification shall be supplemented by any applicable federal, state and local building codes, guidelines, regulations, and standards adopted in the immediate geographic area of the Project; insurance rating organizations; including all other Authorities Having Jurisdiction.

1.05 DEFINITIONS

- A. General: Definitions in the ANSI A108 Series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Module Size: Actual tile size plus joint width indicated.

- C. Face Size: Actual tile size, excluding spacer lugs.
- D. Wet Area: Tile surfaces that are either soaked, saturated, or regularly and frequently subjected to moisture and liquids (including water), such as gang showers, tub enclosures, showers, laundries, saunas, steam rooms, swimming pools, hot tubs, and exterior areas.

1.06 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
 - 1. Level Surfaces: Minimum 0.6 – Wet
 - 2. Step Treads: Minimum 0.6 – Wet
 - 3. Ramp Surfaces: Minimum 0.8 – Wet
- B. Dynamic Coefficient of Friction: For tiles installed on walkway surfaces, provide products with the followings values as determined by testing identical products per ASTM A 137.1:
 - 1. Level Surfaces: Minimum > 0.42

1.07 ACTION SUBMITTALS

- A. Submit items in accordance with Division 01 Section “Submittal Procedures.”
- B. Product Data: For each type of product indicated, submit two (2) copies of manufacturers’ product data, installation instructions and accessories specified and/or required by manufacturer.
- C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- D. Samples of Verification:
 - 1. Two full-size units of each type and composition of tile and for each color and finish required. If units are larger than 12 by 12 inches, please send a smaller sample unless requested otherwise. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
 - 2. Two full-size units of each type of trim and accessory for each color and finish required.
 - 3. Two thresholds in 6-inch lengths for each color and finish required.
 - 4. Two metal edge strips in 6-inch lengths.

1.08 CLOSEOUT SUBMITTALS

- A. Include maintenance and product data for all items installed.
- B. Tile installation system warranty. Contractor shall obtain required information to meet manufacturers’ claim requirements, i.e., proof of purchase, Installer information and any additional requirements.

1.09 MAINTENANCE MATERIALS SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated. [COORDINATE WITH OWNER/CONTRACTOR.]

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Verify Installer is qualified and approved by Manufacturer/Supplier, with a minimum of five years of continuous, uninterrupted experience in successfully installing 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, and who agrees to employ only skilled tradesmen with a minimum of five years experience.

- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer verifying tile has been produced to meet requirements for ANSI 137.1.
- C. Product Certificates: For each type of product, signed by product manufacturer.
- D. Material Test Reports: For each tile-setting and grouting product.
- E. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- F. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- G. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
 - 1. Stone thresholds
 - 2. Waterproof membrane
 - 3. Crack isolation membrane
 - 4. Joint sealants
 - 5. Metal edge strips
- H. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of each type of floor tile installation.
 - 2. Build mockup of each type of wall tile installation.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Mock-Up Testing: Areas to receive waterproof membrane shall be tested for a minimum of 24 hours or longer as recommended by manufacturer to determine if watertight. Coordinate with waterproof membrane installation section.
- J. Preinstallation Conference: Conduct conference at Project site prior to commencement of field installation with Contractor, Subcontractor, Architect/Designer and others, as required.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.12 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 PRODUCTS

2.01 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. In-Field Blending: For tile exhibiting color variations within ranges approved during Sample submittals, Installer shall blend tile in field by pulling tiles from several different packages to blend colors and to match Architect approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
 1. Where tile is indicated for installation in swimming pools, on exteriors or in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of temporary protective coating specified by tile manufacturer. Do not coat unexposed tile surfaces.

2.02 TILE PRODUCTS

- A. For each tile type, manufacturer, series, color and sizes, see Finish Materials Listing in Finish Drawings. Also see preferred vendor list for manufacturers that may be considered acceptable substitutions and must be submitted in accordance with Division 01 section "product requirements".
- B. Waterproofing membranes, crack isolation membranes, setting materials and grout materials are part of a warranted tile installation system. Coordinate requirements for warranty with manufacturer. Large installations require a job-specific warranty.

2.03 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent hard surface floor finishes at specified door openings. See Floor Transition Details in Finish Drawings.
 1. Bullnose Type: Rounded edges, minimum 1/8-inch radius.
 2. Beveled Edge Type: Maximum 1:2 slope, with lower edge of bevel aligned with or up to 1/16-inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/4-inch or less above adjacent floor surface.
- B. Granite Thresholds: ASTM C615
 1. See Finish Materials Listing and Floor Transition Details in the Finish Drawings.
- C. Marble Thresholds: ASTM C503, with a minimum abrasion resistance of 10 per ASTM C1353 or ASTM C241.
 1. See Finish Materials Listing and Floor Transition Details in the Finish Drawings.
- D. Solid-Surfacing Material Thresholds: Homogeneous solid strips of filled plastic resin complying with ISSFA-2. Provide Standard type.
 1. See Finish Materials Listing and Floor Transition Details in the Finish Drawings.

2.04 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product, selected from the following that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane (Floors and walls at: Exterior Tile Installations; Exterior or Interior Water Features; Central Sterile; Decontamination Rooms; Steam Rooms; Saunas; Hydrotherapy Rooms; Spa Wet Treatment Rooms; Commercial Kitchens; Commercial Dishwashing Areas; Commercial Laundry Areas; Stacked Showers in buildings greater than two stories and other similar wet areas in buildings greater than two stories): System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

1. Products: Subject to compliance with requirements, provide [one of] the following:
 - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane
 - b. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane
 - c. MAPEI Corporation; Mapelastic AquaDefense Premium Waterproofing and Crack-Isolation Membrane
 - d. Merkrete, Parex USA Company, Hydro Guard 2000
- C. Preformed Shower Recesses: Extruded polystyrene niche coated with acrylic polymer finish.
 1. Noble Company (The) - #314, Rectangular Niche
 2. Noble Company (The) - #301, Square Niche
 3. Noble Company (The) - #308, Soap Niche
 4. Noble Company (The) - #304, Wide Combo Niche
 5. Noble Company (The) - #305, Narrow Combo Niche

2.05 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch nominal thickness.
 1. Products: Subject to compliance with requirements, provide Schluter Systems L.P., DITRA in the following locations:
 - a. Elevator cabs
 - b. Post Tension Slab Installations
- C. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
 1. Products: Subject to compliance with requirements, provide [one of] the following:
 - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane
 - b. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane
 - c. MAPEI Corporation; Mapelastic AquaDefense Premium Waterproofing and Crack-Isolation Membrane

2.06 SETTING MATERIALS

- A. Portland Cement Mortar (Thick-Set) Installation Materials: ANSI A108.02
 1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils thick.
 2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
 - a. Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication into lath.
 - b. Base Metal and Finish for Exterior Applications: Zinc-coated (galvanized) steel sheet.
 - c. Weight: 2.5 lb/sq. yd.
 3. Mortar Bed: Subject to compliance with requirements, provide [one of] the following:
 - a. Custom Building Products; CustomFloat Bedding Mortar
 - b. Laticrete International, Inc.; 3701 Fortified Mud Bed
 - c. MAPEI Corporation; 4 to 1 Mud Bed Mix
- B. Dry-Set Portland Cement Mortar (Thin-Set and Medium-Bed) ANSI 118.1: Provide at locations to receive uncoupling membrane.
 1. Products: Subject to compliance with requirements, provide [one of] the following:
 - a. Custom Building Products; Uncoupling Mat Mortar
 - b. Laticrete International, Inc.; No. 317
 - c. MAPEI Corporation; Keraset
 - d. TEC; a subsidiary of H.B. Fuller Company; Full Set Plus
- C. Latex-Portland Cement Mortar (Thin-Set and Medium-Bed): ANSI A118.4
 1. Products: Subject to compliance with requirements, provide [one of] the following:

- a. Custom Building Products; FlexBond Crack Prevention Mortar
 - b. Laticrete International, Inc.; No. 254R Platinum
 - c. MAPEI Corporation; Ultraflex 3
 - d. TEC; a subsidiary of H.B. Fuller Company; FortiFlex 2
 - e. TEC; a subsidiary of H.B. Fuller Company; Super Flex - white at glass tile locations
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.07 GROUT MATERIALS

- A. Polymer-Modified Tile Grout: ANSI A118.7
 - 1. Products: Subject to compliance with requirements, see Finish Material Listing for Basis of Design. Also see preferred vendor list for manufacturers that may be considered acceptable substitutions and must be submitted in accordance with Division 01 Section "product requirements".
- B. Water-Cleanable Epoxy Grout: ANSI A118.3 [with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D.]
 - 1. Products: Subject to compliance with requirements, see Finish Material Listing for Basis of Design. Also see preferred vendor list for manufacturers that may be considered acceptable substitutions and must be submitted in accordance with Division 01 Section "product requirements".

2.08 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."
 - 1. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
 - 1. Products: Subject to compliance with requirements, provide sealants recommended by tile installation systems' warranty manufacturer which maintains warranty.
- D. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.
 - 1. Products: Subject to compliance with requirements, provide sealants recommended by tile installation systems' warranty manufacturer which maintains warranty.

2.09 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for warranted installation systems indicated.
- B. Metal Edge Strips: See Floor Transition Details in the Finish Drawings.
- C. Adhesive for Glass Tile: Product as specified for thin-set cement mortar; 'white' in color unless noted otherwise.
- D. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 - 1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

- E. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- F. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Custom Building Products; Surfacegard Grout and Tile sealer

2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm; dry; clean, free of oil, waxy films, soap, silicones, and curing compounds; maximum variation in the plane or slope – 1/8-inch in 10-ft.
 - 2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer, which maintains tile installation systems warranty.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, install to blend tile from 2 or 3 boxes.
- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.03 TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:

- a. Exterior tile floors
 - b. Tile floors in wet areas
 - c. Tile swimming pool decks
 - d. Tile floors in laundries
 - e. Tile floors composed of tiles 8 by 8 inches or larger
 - f. Tile floors composed of rib-backed tiles
- B. Variation in Surface Plane of Large Format Flooring: Do not exceed 1/8 inch in 10 feet from level or slope indicated when tested with a 10-foot straightedge.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- E. Provide manufacturers' standard trim shapes where necessary to eliminate exposed tile edges.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: See Finish Materials Listing in the Finish Drawings.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
 - 3. Furnish and install movement joints per TCNA Handbook – movement joints EJ171.
 - 4. Contractor to coordinate location of control and isolation joints with Architect upon observation at site.
- J. Thresholds: Install thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-Portland cement mortar (thin set).
 - 2. Do not extend cleavage membrane, waterproofing or crack isolation membrane under thresholds set in dry-set Portland cement or latex-Portland cement mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane, waterproofing or crack isolation membrane with elastomeric sealant.
- K. Metal Edge Strips: Install [at locations indicated] [where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile] [where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated].
- L. Grout Sealer: Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.04 WATERPROOF MEMBRANE INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
 - 1. Locations: Install in the following wet areas:
 - a. Kitchen/Food Servery/Dish Washing
 - b. Vending/Ice Machines
 - c. Hydrotherapy/Spa Wet Treatment
 - d. Saunas and Steam Rooms
 - e. Laundry
 - f. Wet Central Sterile
 - g. Decontamination Showers
 - h. Toilet Areas and Locker Rooms
 - i. Showers
 - j. Fountains
 - k. Janitor Closets
 - l. Any tiled areas with floor drains
- B. Provide full height waterproofing at all wall tile installations listed above.
- C. Do not install tile or setting materials over waterproofing until waterproofing has cured and been flood tested for 24 hours to determine that it is watertight.

3.05 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
 - 1. In areas of new construction or existing construction 5 years old or less specified to receive thin-set floor tile system, install membrane continuous over flooring substrate, from wall to wall.
 - 2. In areas of existing construction more than 5 years old specified to receive a new thin-set floor tile system, install membrane as per manufacturer's recommended width centered over and running parallel with existing cracks in flooring substrate.
- B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.06 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.07 EXTERIOR TILE INSTALLATION SCHEDULE

- A. Exterior Floor Installations:

1. Tile Installation F101-12: Cement mortar bed (thick-set) over waterproof membrane on concrete; TCA F101-12 and ANSI A108.1C
 - a. Thin-Set Mortar for Cured-Bed Method: Latex-Portland cement mortar. Provide medium-bed at all locations with 12" or larger tiles.
 - b. Grout: [Polymer modified] [Water cleanable epoxy] grout
 2. Tile Installation F102-12: Thin-set mortar over waterproof membrane on concrete; TCA F102-12
 - a. Thin-Set Mortar: Latex-Portland cement mortar or medium-bed, latex-Portland cement mortar. Provide medium-bed at all locations with 12" or larger tiles.
 - b. Grout: [Polymer-modified] [Water cleanable epoxy] grout
- B. Exterior Wall Installations:
1. Tile Installation W202E-12: Thin-set mortar over waterproof membrane on concrete or masonry; TCA W202E-12
 - a. Thin-Set Mortar: Latex-Portland cement mortar. Provide medium bed at all locations with 12" or larger tiles.
 - b. Grout: [Polymer-modified] [Water cleanable epoxy] grout.

3.08 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
1. Tile Installation F111-12 (Dry Floors): Cement mortar bed (thick-set) with cleavage membrane; TCA F111-12 and ANSI A108.1C [TILES LARGER THAN 2'X2']
 - a. Thin-Set Mortar for Cured-Bed Method: Medium-bed, latex-Portland cement mortar
 - b. Grout: [Polymer-modified] [Water cleanable epoxy] grout
 2. Tile Installation F121-12 (Wet Floors): Cement mortar bed (thick-set) on waterproof membrane; TCA F121 and ANSI A108.1C [LOCATIONS WITH DRAINS]
 - a. Thin-Set Mortar for Cured-Bed Method: Latex-Portland cement mortar. Provide medium-bed at all locations with 12" or larger tiles.
 - b. Grout: Water cleanable epoxy grout.
 3. Tile Installation F122-12 (Wet Floors): Thin-set mortar on waterproof membrane; TCA F122 [WET AREAS WHERE A DEPRESSED SLAB IS NOT POSSIBLE]
 - a. Thin-Set Mortar: Latex-Portland cement mortar. Provide medium-bed at all locations with 12" or larger tiles.
 - b. Grout: Water-cleanable epoxy grout.
 4. Tile Installation F125-12 (Dry Floors): Thin-set mortar on crack isolation membrane – partial coverage; TCA F125-Partial-12 [RENOVATIONS WHERE CONCRETE SLAB IS MORE THAN 5 YEARS OLD MAY IMPACT WARRANTY – VERIFY WITH MANUFACTURER.]
 - a. Thin-Set Mortar: Latex-Portland cement mortar. Provide medium-bed at all locations with 12" or larger tiles.
 - b. Grout: [Polymer-modified] [Water-cleanable epoxy] grout
 5. Tile Installation F125A-12 (Dry Floors): Thin-set mortar on crack isolation membrane full coverage; TCA F125A-Full-12 [TILES UP TO 2'x2', NEW WORK OR RENOVATIONS WHERE CONCRETE SLAB IS 5 YEARS OLD OR LESS]
 - a. Thin-Set Mortar (Dry Floors): Latex-Portland cement mortar. Provide medium-bed at all locations with 12" or larger tiles.
 - b. Grout: [Polymer-modified] [Water cleanable epoxy] grout
 6. Tile Installation F128-12: Thin-set mortar on uncoupling membrane
 - a. Thin-Set Mortar: Dry-set Portland cement mortar. Provide medium-bed at all locations with 12" or larger tiles.
 - b. Grout: [Polymer-modified] [Water cleanable epoxy] grout
- B. Interior Wall Installations, Metal Studs or Furring:
1. Tile Installation W243-12 (Dry Walls): Thin-set mortar on gypsum board; TCA W243-12
 - a. Thin-Set Mortar: Latex-Portland cement mortar
 - b. Grout: [Polymer-modified] [Water cleanable epoxy] grout

- 2. Tile Installation W245-12 (Wet Walls): Thin-set mortar on coated glass-mat, water-resistant gypsum backer board; TCA W245-12.
 - a. Thin-Set Mortar: Latex-Portland cement mortar
 - b. Grout: Water-cleanable epoxy grout
- C. Shower Receptor and Wall Installations, Metal Studs or Furring:
 - 1. Tile Installation B419-12: Thin-set mortar on coated glass-mat, water-resistant backer board; TCA B419-12 [TUB OR PREFABRICATED SHOWER RECEPTORS]
 - a. Thin-Set Mortar: Latex-Portland cement mortar
 - b. Grout: Water-cleanable epoxy grout
 - 2. Tile Installation B420-12: Thin-set mortar on coated glass-mat, water resistant backer board; TCNA B420-12 [TILE WALLS AND FLOORS]
 - a. Thin-Set Mortar: Latex-Portland cement mortar
- D. Grout: Water-cleanable epoxy grout

END OF SECTION

SECTION 09 50 00
WOOD PANEL CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section

1.02 SUMMARY

- A. Section Includes
 - 1. Solid Wood and Wood veneer ceiling panels
 - 2. Exposed grid suspension system
 - 3. Wire hangers, fasteners, main runners, wall angle moldings and accessories.
- B. Related Sections:
 - 1. Section 09 54 26 - Suspended Wood Ceilings
 - 2. Section 09 53 00 - Acoustical Ceiling Suspension Assemblies
 - 3. Section 09 51 26 - Acoustical Wood Ceilings
 - 4. Section 09 20 00 - Plaster and Gypsum Board
 - 5. Division 23 - HVAC
 - 6. Division 26 - Electrical

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
 - 2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - 3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - 4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - 5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - 6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
 - 7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
 - 8. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
 - 9. ASTM E 1264 Classification for Acoustical Ceiling Products
- B. Hardwood Plywood & Veneer Association (HPVA)
- C. International Building Code
- D. ASHRAE Standard 62.1-2004 Ventilation for Acceptable Indoor Air Quality
- E. NFPA 70 National Electrical Code
- F. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
- G. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
- H. International Code Council-Evaluation Services Report - Seismic Engineer Report
 - 1. ESR 1308 - Armstrong T-Bar or Dimensional Suspension

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.

- B. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part 3, Installation.
- C. Samples: Minimum 3-1/2 inch or 5-1/2 inch samples of specified panel; 8 inch long samples of exposed wall molding and suspension system, including main runner.
- D. Shop Drawings: Illustrating the layout and details of the ceilings. Show locations of items that are to be coordinated with, or supported by the ceilings.
- E. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
- F. All products not conforming to manufacturer's current published values must be removed and dispose. Replace with complying product at the expense of the Contractor performing the work.

1.05 QUALITY ASSURANCE

- A. SINGLE-SOURCE RESPONSIBILITY: PROVIDE CEILING PANEL UNITS AND GRID COMPONENTS BY A SINGLE MANUFACTURER.
- B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: As follows, tested by HPVA (Hardwood Plywood and Veneer Association) under the test standard ASTM E-84 tunnel test and complying with ASTM E 1264 for Class A products.
 - a. Flame Spread: 25 or less
 - b. Smoke Developed: 50 or less
- C. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.
- D. Woodworkds Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.
- E. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, wet work i.e. gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store the wood veneer ceiling panels in a dry interior location in their cartons prior to installation to avoid damage. Store the ceiling panel cartons in a flat, horizontal position. Do not remove the protectors between the panels until installation.
- B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Do not expose the wood veneer ceiling panels to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.
- C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.07 PROJECT CONDITIONS

- A. Prior to installation, the wood veneer ceiling materials are required to reach room temperature and have stabilized moisture content for a minimum of 72 hours.
- B. Do not install the wood veneer panels in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.
- C. As interior finish products, the wood veneer panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

1.08 WARRANTY

- A. Wood Veneer Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:
 - 1. Ceiling Panels: Defects in materials or factory workmanship
 - 2. Grid System: Rusting and manufacturing defects
- B. Warranty Period:
 - 1. Wood veneer panels: One (1) year from date of installation
 - 2. Grid: One (1) year from date of installation
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.09 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Ceiling Units: Furnish quantity of full-size units equal to 5.0 percent of amount installed.
 - 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Ceiling Panels:
 - 1. Armstrong World Industries, Inc.
- B. Suspension Systems:
 - 1. Armstrong World Industries, Inc.

2.02 WOOD VENEER CEILING UNITS

- A. Ceiling Panels Type AP:
 - 1. Surface Texture: Smooth
 - 2. Composition: Wood
 - 3. Species/Finish: Constants Walnut
 - 4. Size: 24 in x 72 in
 - 5. Reveal: Square 15/16 in
 - 6. Profile: 15/16 in
 - 7. Sabin:N/A
 - 8. Edge Banding and Trim: To match face veneer
 - 9. Noise Reduction Coefficient (NRC):
 - 10. Flame Spread: ASTM E84 HPVA Fire Classification (Fire Class)
 - 11. Dimensional Stability: Standard
 - 12. Acceptable Product: WOODWORKS Concealed, Item # 5984W1 as manufactured by Armstrong World Industries
- B. Accesorios WoodWorks:
 - 1. 5986 - T-Bar Hook
 - 2. 6091 - Safety Cable
 - 3. SH12 - Support Hanger

2.03 METAL SUSPENSION SYSTEMS

- A. Components:
 - 1. Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces

chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.

- a. Structural Classification: ASTM C 635 Heavy Duty duty
 - b. Color: Tech Black and match the actual color of the selected ceiling tile, unless noted otherwise.
 - c. Acceptable Product: PRELUDE XL 15/16" Exposed Tee as manufactured by Armstrong World Industries
- B. Attachment Devices:
1. Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties:
1. ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least three design load, but not less than 12 gauge.
- D. Wood Works Edge Moldings and Trim:
1. 7800 - 12' Wall Molding
- E. WoodWorks Suspension Accessories:
1. 5986 - T-Bar Hook
 2. 6091 - Safety Cable
 3. 7127 - Snap-in Access Tool
 4. 789512 - Touch Up Paint

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.
- B. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.03 INSTALLATION

- A. Install suspension system and panels in compliance with ASTM C636; CISCA Seismic Guidelines; approved construction drawings; with the authorities having jurisdiction; and in accordance with the manufacturer's installation instructions.
- B. Install wall moldings at intersection of suspended ceiling and vertical surfaces.

3.04 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 51 13
ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes acoustical panels, exposed suspension systems for ceilings, wire hangers, fasteners, hold-down clips and other related accessories.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Product Data: Manufacturer's technical product data and specifications for each type of product indicated, including material descriptions, standard details, dimensions of individual components, profiles, and installation instructions. Include all test reports certifying that products have been tested and comply with performance requirements.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Two (2) 6-inch-square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Two (2) minimum 6-inch-long samples of each type, finish, and color.
- E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Size and location of initial access modules for acoustical panels.
 - 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures and lighting tracks
 - b. Air outlets and inlets
 - c. Speakers and other AV products
 - d. Sprinklers
 - e. Access panels
 - f. Equipment mounts, tracks and rigging points
 - 5. Perimeter moldings.

1.04 INFORMATIONAL SUBMITTALS

- A. Product Tests Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- C. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.
- B. Warranty Information: For products specified.

1.06 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. Acoustical Ceiling Panels: One full carton for each product type of tile used in the project.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
- B. Work of this Section to be installed by a company or individual, qualified and approved by Manufacturer/Supplier, knowledgeable in the proper use and handling of materials specified herein, with a minimum of ten (10) years of continuous, uninterrupted experience in successfully installing 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, and who agrees to employ only skilled tradesmen for the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach a uniform room operating temperature and a stabilized moisture content as per manufacturer's recommendations.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.09 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.10 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.11 WARRANTY

- A. Warranties: General and special warranties specified in this Article will not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and are in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
 - 1. Pass-through warranties provided by subcontractors to manufacturer are not acceptable.
- B. Acoustical Panel Ceilings: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
 - 1. Acoustical Panels: Sagging and warping as a result of defects in materials or factory workmanship.
 - 2. Grid System: Rusting and manufacturer's defects.
 - 3. Acoustical Panels Designated as Inherently Resistive to the Growth of Micro-Organisms: Visible sag and will resist the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.
- C. Warranty Period:
 - 1. Acoustical Panels: Ten (10) years from date of Substantial Completion.
 - 2. Grid: Ten (10) years from date of Substantial Completion.

3. Acoustical Panels and Grid Systems Designated as Inherently Resistive to the Growth of Micro-Organisms: Thirty (30) years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials and with a flame-spread of 25 or less.
 2. Smoke-Developed Index: 50 or less.
- C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.02 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations:
 1. Acoustical Ceiling Panel and Suspension System: Obtain from single source from single manufacturer.
- B. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.
- D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type as listed in the drawings.
- E. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.03 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide manufacturer's from HCA's "Preferred Vendor;s List" and the standard panel of configuration indicated in the Products Legend on the Reflected Ceiling Plans, or as otherwise indicated, relative to panel size, thickness, texture/pattern, color, and other characteristics.

2.04 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated or anticipated.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing

according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

- a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - b. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
 - c. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 4. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire (No. 12 Gage) minimum.
- D. Hanger Rods and/or Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- F. Seismic Stabilizer Bars: Manufacturer's zinc-coated perimeter stabilizers designed to accommodate seismic forces.
- G. Seismic Struts: Manufacturer's zinc-coated compression struts designed to accommodate seismic forces.
- H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place or as indicated in Drawings.
- I. Hold-Down Clips: Where indicated by ceiling type, in areas required by Authorities Having Jurisdiction, and/or for fire-resistance rating requirements summarized below, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.
1. Panels weighing less than 1 lb/sq. ft.: Hold-down clips are required for fire-resistance-rated ceilings to comply with UL design requirements.
 2. Panels weighing more than 1 lb/sq. ft.: Hold-down clips are NOT required for fire-resistance-rated ceilings to comply with UL design requirements.
- J. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
- K. Clean-Room Gasket System: Where indicated, provide manufacturer's recommended system, including neoprene antimicrobial gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.
- L. Hospital MRI Area: Ceiling grid, attachment devices, fasteners, wire hangers, hanger rods, angle hangers, braces, ties, supports and all other finish and installation materials to be manufactured from aluminum, stainless steel (Grade 304) and all other items to be non-ferrous and sized to meet requirements herein.

2.05 METAL SUSPENSION SYSTEM

- A. Subject to compliance with requirements, provide manufacturer's standard grid system indicated in the Products Legend on the Reflected Ceiling Plan relative to grid profile/size and other characteristics. Installer to verify that the specified panel and grid system are compatible before installation of grid begins.

1. Metal Edge Moldings and Trim: Subject to compliance with requirements, provide the products indicated in the Products Legend on the Reflected Ceiling Plan relative to metal edge moldings profile/size and other characteristics or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal or aluminum, of same material, finish, and color as that used for exposed flanges of suspension system runners.
- B. Exposed Tee Ceiling Systems:
1. Wide-Face (15/16-inch), Capped, Double-Web, Hot-Dip Galvanized Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, prepainted, with prefinished cold rolled 15/16-inch-wide steel caps on flanges. Provide fire-resistance rated system where required.
 - a. Structural Classification: Intermediate-duty system, or greater as otherwise required to comply with seismic regulations.
 - b. Cross Tee/Main Beam Interface: Flush fit
 - c. Face Design: Flat
 - d. Cross Tee End Connection: "Stab T"
 - e. Cap Finish: White unless noted otherwise. See Reflected Ceiling Plan.
 - f. Narrow-Face (9/16-inch), Capped, Double-Web, Hot-Dip Galvanized Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, prepainted, with prefinished cold-rolled 9/16-inch-wide steel caps on flanges. Provide fire-resistance rated system where required.
 - 1) Structural Classification: Intermediate-duty system, or greater as otherwise required to comply with seismic regulations.
 - 2) Cross Tee/Main Beam Interface: Flush fit
 - 3) Face Design: Flat
 - 4) Cross Tee End Connection: "Stab T"
 - 5) Cap Finish: White unless noted otherwise. See Reflected Ceiling Plan.
- C. Bolt-Slot Ceiling System:
1. Narrow-Face (9/16-inch) with Reveal, Uncapped, Double-Web, Hot-Dip Galvanized Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, prepainted, to produce structural members with 9/16-inch-wide faces.
 - a. Structural Classification: [Intermediate-duty system, or greater as otherwise required to comply with seismic regulations] [Heavy-duty system].
 - b. Cross Tee/Main Beam Interface: Flush fit
 - c. Face Design: Flanges formed with an integral center [1/8-inch-wide, slotted, box-shaped reveal] [1/4-inch-wide, slotted, box-shaped reveal] [Screw-slot profile] [stepped design with a center protrusion projecting 19/64 inch below flange surfaces supporting panel faces and forming 3/16-inch-wide reveals between edges of protrusion and those of panels].
 - d. Cross Tee End Connection: "Stab T"
 - e. Face and Reveal Finish: White unless noted otherwise. See Reflected Ceiling Plan.
- D. Dimensioned Tee Ceiling System:
1. Narrow-Face (9/16-inch) with Dimensioned Tee, Uncapped, Double-Web, Aluminum or Hot-Dip Galvanized Steel Suspension System: Main and cross runners [extruded aluminum <for horizontal reveal shaped>] [roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation <for raised box shape>], prepainted, to produce structural members with 9/16-inch-wide faces.
 - a. Structural Classification: Intermediate-duty system [Heavy-duty system]
 - b. Cross Tee/Main Beam Interface: Flush fit
 - c. Face Design: [Raised box shaped] [Horizontal reveal shaped]
 - d. Cross Tee End Connection: "Stab T"

- e. Face and Reveal Finish: White unless noted otherwise. See Reflected Ceiling Plan.
- E. Clean Room Ceiling System:
 - 1. Gasketed System: Wide-face (15/16- or 1-1/2-inch), capped, double-web, co-extruded aluminum suspension system, ASTM B 221, applications up to Class 5 performance per ISO standard; chemical resistant; main and cross runners formed from non-magnetic extruded aluminum, prepainted, with prefinished cold-rolled 15/16- or 1-1/2-inch-wide aluminum caps on flanges.
 - a. Structural Classification: Intermediate-duty system [Heavy-duty system]
 - b. Cross Tee/Main Beam Interface: Flush fit
 - c. Face Design: Flat
 - d. Cross Tee End Connection: "Stab T"
 - e. Cap Finish: White unless noted otherwise. See Reflected Ceiling Plan.
 - f. Gasket System: Clean-room type, factory applied.
 - 2. Un-Gasketed System: Wide-face (15/16- or 1-1/2-inch), capped, double-web, hot-dip galvanized steel suspension system, ASTM C 645, main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (G-90 for areas which require or use scrubbable ceilings at all exterior applications) coating designation, unpainted, with prefinished cold-rolled 15/16-inch-wide steel caps on flanges. Provide fire-resistance rated system where required.
 - a. Structural Classification: Heavy-duty system
 - b. Cross Tee/Main Beam Interface: Override type
 - c. Face Design: Flat
 - d. Cross Tee End Connection: "Stab T"
 - e. Cap Finish: White unless noted otherwise. See Reflected Ceiling Plan.
- F. Environmental Tee Ceiling System:
 - 1. Wide-Face (15/16-inch), Capped, Double-Web, Hot-Dip Galvanized Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G60 (G-90 for areas which require or use scrubbable ceilings and at all exterior applications) coating designation, prepainted, with prefinished cold-rolled 15/16-inch-wide steel caps on flanges. Provide fire-resistance rated system where required.
 - a. Structural Classification: Intermediate-duty [Heavy-duty] system
 - b. Cross Tee/Main Beam Interface: Flush fit
 - c. Face Design: Flat
 - d. Cross Tee End Connection: "Stab T"
 - e. Cap Finish: White unless noted otherwise. See Reflected Ceiling Plan.
- G. Hospital MRI Ceiling System:
 - 1. Aluminum: Wide-face (15/16-inch), capped, double-web suspension system, chemical resistant; main and cross runners roll formed from aluminum sheet, with prefinished 15/16-inch-wide aluminum caps on flanges.
 - a. Structural Classification: Intermediate-duty system
 - b. Cross Tee/Main Beam Interface: Flush fit
 - c. Face Design: Flat
 - d. Cross Tee End Connection: "Stab T"
 - e. Cap Finish: White unless noted otherwise. See Reflected Ceiling Plan.
- H. 360° Painted Grid Ceiling System:
 - 1. Narrow-Face (9/16-inch) or Wide-Face (15/16-inch), Uncapped, Double-Web, Hot-Dip Galvanized Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; to produce 360 deg. prepainted structural members with 9/16- or 15/16-inch-wide faces.
 - a. Structural Classification: Heavy-duty system
 - b. Cross Tee/Main Beam Interface: Override type
 - c. Face Design: Flat, flush

- d. Cross Tee End Connection: "Stab T"
 - e. Finish: White unless noted otherwise. See Reflected Ceiling Plan.
- I. 3-Dimensional Ceiling System:
- 1. Narrow-Face (9/16-inch) or Wide-Face (15/16-inch), Uncapped, Double-Web, Extruded Aluminum and Hot-Dip Galvanized Steel Suspension System: ASTM B 221, Class A; 9/16- or 15/16-inch-wide extruded aluminum main beams; 9/16-inch-wide steel cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; prepainted, to produce structural members with 9/16- or 15/16-inch-wide faces.
 - a. Structural Classification: N/A
 - b. Cross Tee/Main Beam Interface: Flush fit
 - c. Face Design: Flat
 - d. Cross Tee End Connection: "Stab T"
 - e. Grid Configuration: Arch and reverse arch
 - f. Edge Profile: Hemmed
 - g. Finish: White unless noted otherwise. See Reflected Ceiling Plan.
- J. Vaulted Ceiling System:
- 1. Wide-Face (15/16-inch), Uncapped, Double-Web, Extruded Aluminum and Hot-Dip Galvanized Steel Suspension System: ASTM B 221, Class A; 15/16-inch-wide extruded aluminum main runners; 9/16-inch-wide steel cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; prepainted, to produce structural members with 15/16-inch-wide faces.
 - a. Structural Classification: N/A
 - b. Cross Tee/Main Beam Interface: Flush fit
 - c. Face Design: Flat
 - d. Cross Tee End Connection: "Stab T"
 - e. Grid Configuration: Arch
 - f. Edge Profile: Hemmed and upturn
 - g. Finish: White unless noted otherwise. See Reflected Ceiling Plan.

2.06 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - 2. Acoustical Sealant for Concealed Joints:
 - a. Henkel Corporation; OSI Sealants Pro-Series SC-175 Rubber Base Sound Sealant.
 - b. Pecora Corporation; AIS-919.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.
- B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
 - 2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.

2.07 MISCELLANEOUS MATERIALS

- A. Acoustical Tile Adhesive: Type recommended by acoustical tile manufacturer, bearing UL label for Class 0-25 flame spread.
- B. Staples: 5/16-inch- (8-mm-) long, divergent-point staples.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected in a manner acceptable to the Installer, and in compliance with manufacturer's warranty requirements.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
- B. Sprayed Fire-Resistive Materials: Coordinate the installation of acoustical panel ceiling assemblies with the applied fireproofing so both elements of Work remain complete and undamaged. Patch or replace applied fire-resistive materials removed or damaged during installation of acoustical panel ceilings assemblies. Comply with requirements specified in Division 07 Section "Applied Fireproofing."
- C. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of wire hanger brackets and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.03 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of four tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 12. Verify the maximum length and size of anchors with structural engineer.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 6. Install hold-down and impact clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
 7. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
 8. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.04 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:
1. Compliance of seismic design.
 2. Suspend ceiling systems.
 3. Hangers, anchors and fasteners.
 4. Other required inspections required by Authorities Having Jurisdiction.

- B. Testing Agency: Owner has the option to engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
 - 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
 - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.05 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Resilient base
 - 2. Resilient stair accessories
 - 3. Resilient molding accessories
 - 4. Adhesive and related accessories

1.03 ACTION SUBMITTALS

- A. Submit items in accordance with Division 01 Section "Submittal Procedures."
- B. Product Data: For each type of product indicated, submit two (2) copies of manufacturers' product data, installation instructions, and accessories specified and/or required by manufacturer.
- C. Samples for Verification: Submit two (2) samples for each type of product indicated in manufacturer's standard-size, but not less than 12 inches long, of each resilient product color, texture, and pattern required.
- D. Product Schedule: See Finish Materials Listing in Finish Drawings.

1.04 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials/attic stock that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than [10 linear feet] for every [500 linear feet] or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Mockups: Provide resilient products with mockups specified in other Sections.
- C. Concrete Sealer Installer Qualifications: Installer trained and certified by sealer manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.07 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 PRODUCTS

2.01 RESILIENT BASE

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, see Finish Materials Listing for Basis of Design and HCA Preferred Vendor List for acceptable manufacturer.
- B. Resilient Base Standard: ASTM F 1861
 - 1. Material Requirement: Type TS (rubber, vulcanized thermoset)
 - 2. Manufacturing Method: Group I (solid, homogeneous)
 - 3. Style: See Finish Materials Listing in Finish Drawings.
- C. Minimum Thickness: See Finish Materials Listing in Finish Drawings.
- D. Height: See Finish Materials Listing in Finish Drawings.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed
- G. Inside Corners: Job formed
- H. Finish Colors and Patterns: See Finish Materials Listing in Finish Drawings.

2.02 RESILIENT STAIR ACCESSORIES

- A. Resilient Stair Treads:
 - 1. Manufacturers: Products: Subject to compliance with requirements, see Finish Materials Listing for Basis of Design and HCA Preferred Vendor List for acceptable manufacturer.
- B. Resilient Stair Treads Standard: ASTM F 2169.
 - 1. Material Requirement: Type TS (rubber, vulcanized thermoset)
 - 2. Surface Design:
 - a. Class 1, Smooth (flat)
 - 3. Manufacturing Method: Group 1, tread with embedded abrasive strips.
- C. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees
- D. Nosing Height: 1-1/2 inches
- E. Thickness: 1/4 inch (6 mm) and tapered to back edge
- F. Size: Lengths and depths to fit each stair tread in one piece.
- G. Risers: Smooth, flat, coved-toe, 7 inches high by length matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
 - 1. Thickness: [0.125 inch (3.2 mm)]
- H. Stringers: Of same thickness as risers, height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- I. Colors and Patterns: See Finish Materials Listing in Finish Drawings.

2.03 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessory:
 - 1. Products: Subject to compliance with requirements, see Finish Materials Listing for Basis of Design and HCA Preferred Vendor List for acceptable manufacturer.
- B. Description: See Finish Materials Listing and floor transition details in Finish Drawings.
- C. Material: As standard with manufacturer.
- D. Profile and Dimensions: See Finish Materials Listing and floor transition details in Finish Drawings.
- E. Colors and Patterns: See Finish Materials Listing and floor transition details in Finish Drawings.

2.04 INSTALLATION MATERIALS

- A. Substrate Preparation Products:

1. Trowelable Leveling and Patching Compounds: Portland cement-based or blended hydraulic cement-based formulation provided or approved by floor covering manufacturer for applications indicated. Products for manufacturers' consideration are Armstrong S-184 or S-194 (leveling or patching), Ardex SP-F Feather Finish (patching), K-15 (leveling) or Concure Feather Cement (patching), SL-1 (leveling).
 2. Moisture Mitigation Product – Concure Vapor Barrier Two-Step System; Concure Corporation, Collingdale, PA.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.
 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- E. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after all substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate allowed by manufacturer(s) for each product specified in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum relative humidity level measurement allowed by manufacturer(s) for each product specified.
 - c. If required, apply the moisture mitigation product per the manufacturer's recommendations and provide any additional calcium chloride testing of the prepared substrate per moisture mitigation manufacturer's recommendations prior to installation of floor covering and register results with the moisture mitigation manufacturer, General Contractor, Owner and Architect.

5. After installation of vapor sealer and before flooring installation, conduct 72 - hour bond test to verify adhesion of each required type of flooring adhesive to concrete vapor sealer. Provide written report on such testing.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 2. Inside Corners: Use straight pieces of maximum lengths possible.

3.04 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 2. Tightly adhere to substrates throughout length of each piece.
 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of all resilient floor covering that would otherwise be exposed per floor transition details.

3.05 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surfaces thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
 1. Apply liquid floor polish per manufacturers' recommendations.

- E. Joint Sealant: Coordinate with floor finish material for requirements concerning applying sealant at door frames and other joints and penetrations.
- F. Cover resilient products until Substantial Completion.

END OF SECTION

SECTION 09 68 13

CARPET TILE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Furnish labor, materials, tools and other equipment, and services necessary to provide surface preparation and the installation of carpet tile, including all components and accessory items required for a complete installation.
 - 1. Modular Carpet
- B. Work under this Section also includes moisture and alkalinity testing, and surface preparation of substrates as required for acceptance of carpet tile, including but not necessarily limited to, cleaning, small crack repair, patching, filling, any other Work required to provide an appropriate substrate.
- C. This specification shall be supplemented by any applicable federal, state and local building codes, guidelines, regulations, and standards adopted in the immediate geographic area of the Project; insurance rating organizations; including all other Authorities Having Jurisdiction.

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site prior to commencement of field installation with Contractor, Subcontractor, Architect/Designer and others, as required.
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include installation recommendations and accessories specified and/or required by manufacturer for each type of substrate.
 - 3. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
 - 4. Warranty: For each type indicated, copy of manufacturer's warranty.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type and color.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.
 - 9. Type, color, and location of edge, transition, and other accessory strips.
 - 10. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Submit two (2) full-size Samples.

2. Exposed Edge, Transition, and Other Accessory Stripping: Submit two (2) 12-inch long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.05 CLOSEOUT/MAINTENANCE MATERIAL SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.06 EXTRA MATERIAL

- 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. [COORDINATE WITH OWNER/CONTRACTOR.]
 2. Deliver usable carpet tiles to Owner. Neatly package and wrap such carpet tiles for storage protection. Do not include miscellaneous scrap pieces as part of the specified extra materials.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level. Verify Installer is approved by manufacturer, with a minimum of five years continuous, uninterrupted experience in successfully installing 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, and who agrees to employ only skilled tradesmen with a minimum of five years' experience.
- B. Fire-Test-Response Ratings: Provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 or ASTM E648 by a qualified testing agency.
- C. Carpet shall have smoke density development of 450 or less per NBS Smoke Chamber Test NFPA 258 or ASTM E 662.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockups at locations and in sizes 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.
- E. Factory Runs: Produce carpet tile, of each type specified, in one factory run and from one dye lot. Guarantee colors and shades to be uniform throughout the run of material.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.
- B. Arrange, in advance of delivery, with General Contractor for secure, clean, dry storage space.

1.09 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet Work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Install carpet tile after other finishing operations, including all painting, ceilings, and any overhead work have been completed.

- E. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: Minimum 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 CARPET TILE

- A. Products: Subject to compliance with requirements, See Finish Materials Listing for Basis of Design. Also see preferred Vendor List for manufacturers that may be considered acceptable substitutions and must be submitted in accordance with Division 01 Section "product requirements".

2.02 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
- C. Metal Edge/Transition Strips: See Floor Transition Details in the Finish Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 4. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
- C. For metal subfloors, verify the following:
 - 1. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- D. For painted subfloors, verify the following:
 - 1. Perform bond test recommended in writing by adhesive manufacturer.
- E. For raised access flooring systems, verify the following:
 - 1. Access floor complies with installation requirements specified in Division 09 Section "Access Flooring."
 - 2. Access floor substrate is compatible with carpet tile and adhesive if any.

3. Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than 1/8 inch, protrusions more than 1/32 inch, and substances that may interfere with adhesive bond or show through surface.
- F. Proceed with installation only after substrates pass testing and unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.03 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive
- C. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- F. Install pattern parallel to walls and borders. See Finish Drawings per patterns and layouts.
- G. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.
- H. Install edge strips and trim in accordance with manufacturer's written instructions concealing exposed edges.
- I. Do not place furniture or heavy objects on carpeted surfaces for a minimum of 2 hours or until adhesive has set.

3.04 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 2. Remove yarns that protrude from carpet tile surface.
 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile with non-staining building material paper, hard board or plywood to comply with CRI 104, Section 16, "Protecting Indoor Installations." Do not use plastic sheeting.

- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 09 91 00

PAINTING, COATINGS, STAINING AND TRANSPARENT FINISHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Furnish labor, materials, tools and other equipment, and services necessary to provide the surface preparation and the application of paints, high performance coatings, stains and transparent finish systems, including all accessory items as required for a complete installation:
 - 1. Interior and exterior, vertical and horizontal substrates:
 - a. Concrete
 - b. Clay masonry
 - c. Concrete masonry units (CMU)
 - d. Steel (ferrous metal)
 - e. Galvanized and nonferrous metal
 - f. Aluminum (not anodized or otherwise coated)
 - g. Stainless steel flashing
 - h. Wood (Exposed glue-laminated beams and columns, exposed dimension lumber, dressed lumber, exposed wood panel products)
 - i. Gypsum board (Interior and Exterior)
 - j. Plaster
 - k. Spray textured ceilings
 - l. Cotton or canvas insulation covering
 - m. ASJ insulation covering (mechanical pipe insulation)
 - n. Plastic trim fabrications
- B. Work under this Section also includes moisture and alkalinity testing, and surface preparation of substrates as required for acceptance of finishes, including but not necessarily limited to, cleaning, small crack repair, patching, sanding, caulking, any other work required to provide smooth substrates, and specific pre-treatments such as sealing and priming of surfaces to the limits defined within the Master Painters Institute's (MPI) "Architectural Painting Manual" and/or "Maintenance Repainting Manual."
- C. Related Requirements:
 - 1. Division 01 Section "Temporary Facilities and Controls" for temporary/permanent climate requirements.
 - 2. Division 03 Section "Cast-In-Place Concrete" for special finishes.
 - 3. Division 04 Section "Unit Masonry" for paints and sealers over concrete or clay units.
 - 4. Division 05 Sections for shop priming of metal substrates such as exposed structural steel, decking and miscellaneous metal which is not scheduled to have fire-resistive materials with primers and finish paints specified in this Section.
 - 5. Division 06 Sections for shop priming carpentry with primers specified in this Section.
 - 6. Division 07 Section "Traffic Coatings" for pedestrian traffic coatings, vehicular traffic coatings, equipment room floor coatings, and pavement-marking paints.
 - 7. Division 08 Sections for factory priming wood windows and doors with primers specified in this Section.
 - 8. Division 09 Section "Gypsum Board" for surface preparation of gypsum board.
 - 9. Division 09 Painting Sections for special-use coatings.
 - 10. Divisions 22, 23 and 26 for additional painting, color coding and stenciling requirements.
 - 11. Division 32 for alkyd-resin and glass bead pavement-marking paints and decorative concrete staining.

1.03 REFERENCE STANDARDS

- A. The following reference standard shall be used in conjunction along with additional more stringent information stated herein:
 - 1. Master Painters Institute (MPI)
 - a. MPI Architectural Painting Specification Manual
 - b. This specification shall be supplemented by any applicable federal, state and local building codes, guidelines, regulations, and standards adopted in the immediate geographic area of the Project; insurance rating organizations; including all other Authorities Having Jurisdiction.

1.04 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.05 ACTION SUBMITTALS

- A. Submit items in accordance with Division 01 Section "Submittal Procedures."
- B. Product Data: For each type of product indicated, submit two (2) copies of manufacturers' product data, installation instructions and accessories specified and /or required by manufacturer.
- C. Samples for Verification:
 - 1. For each type of paint and high-performance coating system and in each color and gloss of topcoat:
 - a. Submit two (2) Samples on rigid backing, 8 inches square.
 - b. Step coats on Samples to show each coat required for system.
 - c. Label each coat of each Sample.
 - d. Label each Sample for location and application area.
 - e. For each type of stain and transparent finish system and in each color and gloss of finish indicated.
 - 1) Submit two (2) Samples on representative samples of actual wood substrates, 8 inches square.
 - 2) Label each Sample for location and application area.
- D. Product List: For each product indicated, submit two (2) copies. Include the following:
 - 1. Indicate each product and cross-reference to finish system color including locations of application areas. Use same designations indicated on Drawings and in schedules. Provide Final Product List and include Finish System Chart in closeout documents.
 - 2. VOC content of each product specified.
 - 3. Include product list in closeout Submittals.

1.06 MISCELLANEOUS 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. Paint, high-performance coatings, stains and transparent finishes: 1 gal. of each material, color and finish applied.
- B. Oils, turpentine, and other materials required to accomplish this work shall be first quality materials.

- C. Thinners shall be of a type as recommended by the paint manufacturer for each product specified.
- D. Turpentine shall comply with requirements of Federal Specification TT-T-801.
- E. Mineral Spirits shall comply with requirements of Federal Specification TT-T-291 Grade 1.

1.07 QUALITY ASSURANCE

- A. Applicator Qualifications: A company or individual, qualified and approved by Manufacturer/Supplier, with a minimum of five years of continuous, uninterrupted experience in successfully applying work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance, and who agrees to employ only skilled tradesmen with a minimum of three years' experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers with original labels in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F nor greater than 90 deg F and/or more restrictive requirements as per manufacturer.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.
- B. Conform to requirements of local Authorities Having Jurisdiction in regard to the handling, mixing, application and disposal of all paint materials, related waste materials, and/or hazardous materials.

1.09 FIELD CONDITIONS

- A. Apply paints, high performance coatings, stains and transparent finishes only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F and/or more restrictive requirements as per manufacturer.
- B. Do not apply paints, high-performance coatings, stains and transparent finishes when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp, wet and/or unprepared surfaces. Coordinate any more restrictive requirements with manufacturer.
- C. Only apply paints when atmosphere is relatively free of airborne dust and contaminants.
- D. When dry abrasive blasting carbon steel surfaces, the dew point temperature in the space must be maintained at least 17 deg F. lower than the temperature of the surface being prepared or greater as per manufacturers' recommendations.
- E. During paint and coating application, the dew point temperature in the space must be maintained at least 10 deg F. lower than the temperature of the surface being painted along with additional more stringent parameters set forth by paint and coating manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The "Basics of Design" is the Sherwin-Williams Co., as listed in Section 3.06, Painting Schedule. These establish performance requirements and a standard of quality, unless otherwise specified. Substitutions shall be manufactures as listed in the Manufacturers: Subject to compliance with requirements, provide products by manufacturers listed in Document 002150 - Owner's Preferred Vendor List. No substitutions permitted..

2.02 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

3. Provide products of same manufacturer from each coat in a finishing system and prepare paints as per manufacturer's recommendations.
- B. VOC Content: Products shall comply with VOC limits of Authorities Having Jurisdiction
- C. Colors: See the Finish Materials Listing in the Finish Drawings.

2.03 SOURCE QUALITY CONTROL

- A. Testing of Finish Materials: Owner reserves the right to invoke the following procedure:
 1. Owner will engage the services of a qualified testing agency to sample paint, high-performance coatings and wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints, high-performance coatings and wood finishing if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces if, on refinishing with complying materials, the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows (or less as per manufacturer):
 1. Concrete: 12 percent
 2. Masonry (Clay and CMU): 12 percent
 3. Wood: 15 percent
 4. Portland Cement Plaster: 12 percent
 5. Gypsum Board: 12 percent
 6. Plaster: 12 percent
- C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.
- D. Interior and Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- E. Plaster Substrates: Verify that plaster is fully cured.
- F. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- G. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- H. Verify gypsum board finish level prior to application of paints and high-performance coatings.
 1. Gloss, semi-gloss and high-performance coatings - Level 5 Drywall Finish
 2. Satin, eggshell and flat paints - Level 4 Drywall Finish
- I. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and finish systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be finished. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing finish operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, high-performance coatings, stains and transparent finishes including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce finish systems indicated.
- D. Concrete Substrates: Allow concrete to cure for 28 days. Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 1. Concrete Floors: Prepare concrete floors by abrasive blast cleaning and/or mechanically profiling in accordance with manufacturer's recommendations. Acid etching may be used if specifically recommended by manufacturer.
 2. High Performance Coatings:
 - a. Clean surfaces with pressurized water. Use pressure range in accordance with MPI Manual.
 - b. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- E. Masonry Substrates: Allow masonry to cure for 28 days. Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
 1. High-Performance Coatings:
 - a. Clean surfaces with pressurized water. Use pressure range in accordance with MPI Manual.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 1. Paints:
 - a. SSPC-SP 2, "Hand Tool Cleaning."
 - b. SSPC-SP 3, "Power Tool Cleaning."
 - c. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 - d. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 2. High-Performance Coatings:
 - a. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
 - b. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 - c. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - d. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
 - e. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints or high-performance coatings. Damaged galvanized areas shall be cleaned as per manufacturers' recommendations and shall be coated with zinc rich paint prior to and additional finish painting.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 1. Wood substrates to be finished with paint or high-performance coatings.
 - a. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for use in paint system indicated.
 - b. Sand surfaces that will be exposed to view, and dust off.
 - c. Prime edges, ends, faces, undersides, and backsides of wood.

- d. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- 2. Wood substrates to be stained:
 - a. Exterior Wood Substrates:
 - 1) Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2) Prime edges, ends, faces, undersides, and backsides of wood.
 - (a) For varnish coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.
 - 3) Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.
 - b. Interior Wood Substrates:
 - 1) Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2) Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
 - 3) Sand surfaces that will be exposed to view and dust off.
 - 4) After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
- L. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
- M. Mold and/or Mildew: Notify Owner and Architect of all locations where mold/mildew is discovered prior to proceeding with application of any finish systems. Removal of substrate material will be required at all gypsum product locations and at other areas as per Owner/Architect's direction.

3.03 APPLICATION

- A. Apply paints, high-performance coatings, stains and transparent finishes according to manufacturer's written instructions and recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for finish system and substrate indicated.
 - 2. Finish surfaces behind movable items same as similar exposed surfaces. Before final installation, finish surfaces behind permanently fixed items with prime coat only.
 - 3. Finish both sides and edges of doors and entire exposed surface of door frames.
 - 4. Finish front and back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 5. Prime glazing stops and glazing beads before glass is installed.
 - 6. Finish entire exposed surface of window frames and sashes.
 - 7. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 8. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply finishes to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Apply a minimum of four coats of paint or high-performance coating to surfaces specified to receive deep or bright colors.
- F. Backprime exterior and interior woodwork which is to receive paint finish, with exterior primer.

- G. Remove grilles, covers, and access panels and paint separately.
- H. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following Work where exposed in equipment rooms:
 - a. Equipment, including panelboards, switch gear tanks, stands and supports
 - b. Uninsulated metal piping
 - c. Uninsulated plastic piping
 - d. Pipe hangers and supports
 - e. Metal conduit
 - f. Plastic conduit
 - g. Tanks that do not have factory-applied final finishes
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - i. Equipment, stands, supports, intake bonnets, flutes and all factory-primed items to receive final paint that are exposed to view in equipment rooms, on the roof or outside the building.
 - 2. Paint the following Work where exposed in occupied spaces:
 - a. Equipment, including panelboards
 - b. Uninsulated metal piping
 - c. Uninsulated plastic piping
 - d. Pipe hangers and supports
 - e. Metal conduit
 - f. Plastic conduit
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material
 - h. Other items as directed by Architect.
 - i. Equipment, stands, supports, intake bonnets, flutes and all factory-primed items to receive final paint that are exposed to view in equipment rooms, on the roof or outside the building.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces with primer and one coat of "black" (non-reflecting) paint recommended by manufacturer.
 - 4. Paint disconnect switches for fire alarm system and exit light systems in 'red' enamel, unless factory finished in specified color.
 - 5. Keep all sprinkler heads and escutcheons free of paint.
 - 6. Backprime and paint face and edges of fire-retardant plywood service panels for telephone and electrical equipment before installation, to match adjacent wall surface. Leave equipment in original finish except for touch up as required, and paint conduits, mounting accessories and other unfinished items.
 - 7. Any code required fire-retardant wood/plywood used for electrical and/or telephone equipment shall retain one grade/label stamp free from paint.

3.04 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test finishes for dry film thickness.
 - 1. Contractor shall touch up and restore finished surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied finish does not comply with manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with manufacturer's written recommendations.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

- B. After completing finish application, clean spattered surfaces. Remove spattered finishes by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted or finished surfaces.

3.06 PAINTING SCHEDULE

- A. EPS-1: Concrete, Dense Masonry, Porous Block, Brick or Stucco [SMOOTH FINISH]
 - 1. Acrylic Coating
 - 2. Finish: Flat
 - a. 1st Coat: Concrete, Dense Masonry, Brick and Stucco - Loxon Acrylic Primer #A24W300
 - b. Block, Split Face and Fluted Block - Loxon Block Surfer #A24W200
 - c. 2nd & 3rd Coats: Loxon Acrylic Coating #A24W300 Series
- B. EPS-3: Steel, Galvanized Steel or Nonferrous Metals
 - 1. Acrylic Coating
 - 2. Finish: Semi-Gloss
 - a. 1st Coat: DTM Primer Acrylic Primer/Finish #B66W1
 - b. 2nd & 3rd Coats: DTM Acrylic coating #B66-200 Series
- C. EPS-4: Existing Painted or Factory Finished Metal Surfaces [MECHANICAL EQUIPMENT, PRE-PAINTED SURFACES]
 - 1. Alkyd Enamel
 - 2. Finish: Gloss
 - a. 1st Coat: Kem Kromik Universal Metal Primer #B50NZ6 or #B50WZ1
 - b. 2nd Coat: Industrial Enamel HS #B54Z-400 Series
- D. EPS-5: Steel, Galvanized Steel or Non-Ferrous Metals, Existing Painted or Factory Finished Metal Surfaces [HIGH PERFORMANCE COATING SYSTEM - HANDRAILS, EXPOSURE TO SALT-SPRAY, REPAINTING FACTORY FINISHED METAL AREAS HARD TO RE-COAT.]
 - 1. Acrylic Aliphatic Polyurethane
 - 2. Finish: Semi-gloss
 - a. 1st & 2nd Coats: Macropoxy HS High Solids Epoxy #B58 Series
 - b. 3rd Coat: Hi-Solids Polyurethane #B65-350 Series
- E. EPS-6: Drywall or Plaster
 - 1. Acrylic Latex
 - 2. Finish: Flat or Satin
 - a. 1st Coat: A-100 Exterior Latex Primer #B42W41
 - b. 2nd & 3rd Coats: A-100 Exterior Latex Flat #A6-100 Series [OR]
 - 1) A-100 Exterior Latex Satin #A82 Series
- F. EPS-7: Wood, Painted
 - 1. Acrylic Latex
 - 2. Finish: Flat or Satin
 - a. 1st Coat: A-100 Exterior Latex Primer #B42W41
 - b. 2nd & 3rd Coats: A-100 Exterior Latex Flat #A6-100 Series [OR]
 - 1) A-100 Exterior Latex Satin #A82 Series
- G. EPS-8: Wood, Semi-Transparent Stain
 - 1. Polyurethane
 - 2. Finish: Flat
 - a. 1st & 2nd Coats: WoodScapes House Stain #A15T5 Series

- H. EPS-8: Wood, Semi-Transparent Stain [PROVIDES A MORE UNIFORM LOOK ON WOODS WITH IRREGULAR GRAINING PATTERN AND WHEN TOUCHING UP EXISTING IN ADDITION TO STAINING ADJACENT NEW WORK - REVIEW WITH MANUFACTURER.]
 - 1. Alkyd
 - 2. Finish: Flat
 - 3. 1st & 2nd Coats: Exterior Alkyd Semi-Transparent Wood Preservative Stain #A14T5 Series
- I. EPS-9: Concrete Floors, Clear Sealer
 - 1. Alkyd
 - 2. Finish: Flat
 - a. 1st Coat: H & C Concrete and Masonry Waterproofing Sealer #50.043.054 - Applied at manufacturer's recommended application rate. Conduct water test to assure proper seal on concrete. If water does not "bead up" on concrete, apply second coat.
- J. EPS-10: Concrete, Opaque Sealer [AVAILABLE IN ANY SHERWIN WILLIAMS COLOR]
 - 1. Silicone Acrylic
 - 2. Finish: Satin
 - a. 1st & 2nd Coats: H & C Concrete Sealer #10.104.01

3.07 INTERIOR PAINTING SCHEDULE

- A. IPS-1: Concrete, Dense Masonry and Porous Block Substrates [DRY AREAS, NEW WORK ONLY - MEETS LEED REQUIREMENTS]
 - 1. Acrylic Latex
 - 2. Finish: Eggshell or Semi-Gloss [EDIT]
 - a. 1st Coat: Concrete and Dense Masonry - Loxon Concrete and Masonry Primer #A24W8300
 - 1) Block - Loxon Block Surfacer #A24W200
 - b. 2nd & 3rd Coats: ProMar 200 Zero VOC Interior Latex Eg-Shel #B20W2600 Series [OR]
 - c. ProMar 200 Zero VOC Interior Latex Semi-Gloss #B31W2600 Series
- B. IPS-2: Concrete, Dense Masonry and Porous Block Substrates [KITCHENS, TOILETS, SHOWER AREAS AND OTHER WET ENVIRONMENTS - MEETS LEED REQUIREMENTS - WHEN USING EPOXY PAINT ON AN EXTERIOR WALL IN AREAS WITH HIGH HUMIDITY, DISCUSS PERMEABILITY REQUIREMENTS WITH ARCHITECT]
 - 1. Waterbased, Catalyzed, Epoxy Resin High-Performance Coating
 - 2. Finish: Semi-Gloss or Gloss
 - a. 1st Coat: Concrete and Dense Masonry - PrepRite ProBlock Interior/Exterior Latex Primer Sealer #B51 Series
 - b. Block - Loxon Block Surfacer #A24W200
 - c. 2nd & 3rd Coats: Waterbased Catalyzed Epoxy #B70 Series
- C. IPS-3: Steel, Galvanized Steel or Non-Ferrous Metal Substrates [MEETS LEED REQUIREMENTS]
 - 1. Acrylic Enamel
 - 2. Finish: Satin or Semi-Gloss [EDIT]
 - a. 1st Coat: Pro-Cryl Universal Primer #B66-310 Series
 - b. 2nd & 3rd Coats: Pro Industrial Zero VOC Acrylic Eg-Shel #B66-660 Series
 - c. [OR]
 - d. Pro Industrial Zero VOC Acrylic Semi-Gloss #B66-650 Series
- D. IPS-4: All Substrates in Overhead Decking [WET ENVIRONMENTS/POOLS, SKYLIGHTS - MEETS LEED REQUIREMENTS - REVIEW COATINGS WITH MANUFACTURER - WET AREAS REQUIRE SPECIAL ATTENTION.]
 - 1. Acrylic Urethane
 - 2. Finish: Gloss

- a. 1st Coat: Pro-Cryl Universal Primer #B66-310 Series
 - b. 2nd Coat: Waterbased Acrolon 100 Water-Based Urethane #B65 Series
- E. IPS-5: All Substrates in Overhead Decking [DRY ENVIRONMENTS ONLY - MEETS LEED REQUIREMENTS]
 - 1. Waterborne Acrylic Dry Fall
 - 2. Finish: Flat or Eggshell [EDIT]
 - a. 1st Coat: DTM Primer Acrylic Primer/Finish #B66W1
 - b. 2nd Coat Low VOC Waterborne Acrylic Dry Fall Flat #B42W81 Series [WHITE]
[OR]
 - c. Low VOC Waterborne Acrylic Dry Fall Flat #B42B81 Series [BLACK] [OR]
 - d. Low VOC Waterborne Acrylic Dry Fall Eg-Shel #B42W82 Series [WHITE]
- F. IPS-6: Gypsum Wallboard/Plaster Substrates - Ceilings [MEETS LEED REQUIREMENTS]
 - 1. Acrylic Latex
 - 2. Finish: Flat, Eggshell, Semi-Gloss [EDIT]
 - a. 1st Coat: ProMar 200 Interior Latex Primer #B28W8200
 - b. 2nd & 3rd Coats: ProMar 200 Zero VOC Interior Latex Flat #B30W2600 Series [OR]
 - c. ProMar 200 Zero VOC Interior Latex Eg-Shel #B20W2600 Series [OR]
 - d. ProMar 200 Zero VOC Interior Latex Semi-Gloss #B31W2600 Series
- G. IPS-7: Gypsum Wallboard/Plaster Substrates - Walls [MEETS LEED REQUIREMENTS]
 - 1. Acrylic Latex
 - 2. Finish: Eggshell, Semi-Gloss [EDIT]
 - a. 1st Coat: ProMar 200 Interior Latex Primer #B28W8200
 - b. 2nd & 3rd Coats: ProMar 200 Zero VOC Interior Latex Eg-Shel #B20W2600 Series
[OR]
 - c. ProMar 200 Zero VOC Interior Latex Semi-Gloss #B31W2600 Series
- H. IPS-8: Gypsum Wallboard/Plaster Substrates [VERY HARD AND SCRUBBABLE, USE IN WET ENVIRONMENTS - MEETS LEED REQUIREMENTS - WHEN USING EPOXY PAINT ON AN EXTERIOR WALL IN AREAS WITH HIGH HUMIDITY, DISCUSS PERMEABILITY REQUIREMENTS WITH ARCHITECT.]
 - 1. Waterbased, Catalyzed, Epoxy Resin High-Performance Coating
 - 2. Finish: Semi-Gloss or Gloss [EDIT]
 - a. 1st Coat: ProMar 200 Interior Latex Primer #B28W8200
 - b. 2nd & 3rd Coats: Waterbased Catalyzed Epoxy #B70 Series
- I. IPS-9: Wood Surfaces to be Painted [DRY ENVIRONMENTS - MEETS LEED REQUIREMENTS]
 - 1. Latex Enamel
 - 2. Finish: Semi-Gloss
 - a. 1st Coat: Premium Wall & Wood Primer #B28W8111
 - b. 2nd & 3rd Coats: Pro Industrial Zero VOC Acrylic Semi-Gloss #B66-650 Series
- J. IPS-12 Wood Surfaces to have Transparent Finish [DOES NOT MEET LEED REQUIREMENTS - BETTER QUALITY FINISH]
 - 1. Alkyd Varnish System
 - 2. Finish: Satin or Gloss [EDIT]
 - 3. Sand between each coat.
 - a. 1st Coat: Wash coat - One part Wood Classics FastDry Sanding Sealer #B26V43 and 3 parts mineral spirits
 - b. 2nd Coat: If wood has open pores - Apply Sher -Wood Natural Filler #D70T1, tinted to match stained finish.
 - c. 3rd Coat: Stain - Wood Classics Interior Oil Stain #A49-200 Series
 - d. 4th Coat: Sealer - Wood Classics FastDry Sanding Sealer #B26V43
 - e. 5th Coat: Finish - Wood Classics FastDry Oil Varnish #A66-300 Series

- K. IPS-13 Concrete Floors [DOES NOT MEET LEED REQUIREMENTS - USE HAZE GRAY FOR ALL HCA PROJECTS, SPECIFY COLOR SELECTIONS IN FINISH MATERIALS LISTING UNDER PAINTED CONCRETE FLOOR.]
1. Polyamide Epoxy Coating
 - a. Finish: Gloss
 - 1) Primer: Armorseal Floor-Plex 7100 Primer Water Based Epoxy Floor Coating #B70 Series
 - 2) 2nd & 3rd Coats: Armorseal Floor-Plex 7100 Water Based Epoxy Floor Coating #B70 Series [with SharkGrip Additive]
- L. IPS-15: Pipe Identification
1. All piping or piping insulation within each mechanical room, fan room, boiler room, powerhouse and other exposed areas shall be painted in its entirety with DTM Acrylic coating #B66-200 Series. [DOES NOT MEET LEED REQUIREMENTS]
 2. Plumbing:
 - a. Natural Gas - Venture Violet, SW6970
 - b. Propane - Safety Orange
 - c. Fuel Oil - Nomadic Desert, SW6107
 - d. Fire Protection Standpipe and Sprinkler Piping - Safety Red
 - e. Steam Condensate - Osage Orange, SW6890
 - f. Chilled Water - Safety Green
 - g. Condenser Water - Synergy, SW6938
 - h. Hot Water Piping - Merry Pink, SW6844
 - i. Domestic Cold Water - Safety Blue
 - j. Domestic Hot Water - Rose Chintz, SW1587
 - k. Chemical Feed Piping - Safety Yellow
 3. Medical Gases:
 - a. Oxygen - Greens, SW6748
 - b. Nitrous Oxide - Nitrous Oxide - Blueblood, SW6966
 - c. Nitrogen - Nitrogen - Black background with white letters
 - d. Vacuum - White
 - e. Medical Air - Sunrise, 6668
 4. Elevator:
 - a. Hydro Lines - Acapulco Sun, SW1607
 5. Stenciling of all exposed and concealed piping shall be applied in "black" letters and in accordance with Division 22 - Plumbing - using the same coating materials.

3.08 WALLS:

- A. Stencil in contrasting color to background, all corridor partitions, smoke, fire, horizontal exit, exit enclosures and other rated partitions with permanent 3" high letters identifying the name and hour rating of the partition, approximately 8" above the ceiling every 20 feet on both sides of partition, or 10 feet from corners, and identified once in each space having fire-rated or smoke walls. Plenum areas below access flooring shall be stenciled in the same manner as areas above ceilings; however, paint finishes must go all the way down to substrate, not the demarcation line access flooring. Identify walls as applicable, "1-HOUR FIRE," "2-HOUR FIRE, ETC."

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Room and door signs.
- B. Interior directional and informational signs.
- C. Emergency evacuation maps.
- D. Building identification signs.

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.

1. Sign Type: Flat signs with engraved panel media as specified.
 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 3. Character Height: 1 inch.
 4. Sign Height: 2 inches, unless otherwise indicated.
 5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Interior Directional and Informational Signs:
1. Sign Type: Same as room and door signs.
 2. Sizes: As indicated on drawings.
 3. Wording of signs is scheduled on drawings.
 4. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.
- D. Emergency Evacuation Maps:
1. Allow for one map per elevator lobby.
 2. Map content to be provided by Owner.
 3. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.
- E. Building Identification Signs:
1. Use individual metal letters.
 2. Mount on outside wall in location indicated on drawings.
- F. Traffic Signs: To match campus standards; locate where indicated on drawings.

2.02 SIGN TYPES

- A. Flat Signs: Signage media without frame.
1. Edges: Square.
 2. Corners: Radiused.
 3. Wall Mounting of One-Sided Signs: Tape adhesive.
 4. Wall and Ceiling Mounting of Two-Sided Signs: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes, set in clear silicone sealant.
 5. Suspended Mounting: Stainless steel suspension cables, cable clamps, and ceiling fastener suitable for attachment to ceiling construction indicated.
- B. Color and Font: Unless otherwise indicated:
1. Character Font: Helvetica, Arial, or other sans serif font.
 2. Character Case: Upper case only.
 3. Background Color: Clear.
 4. Character Color: Contrasting color.

2.03 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
1. Total Thickness: 1/16 inch.

2.04 NON-TACTILE SIGNAGE MEDIA

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:

1. Sign Color: Clear.
2. Total Thickness: 1/8 inch.

2.05 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

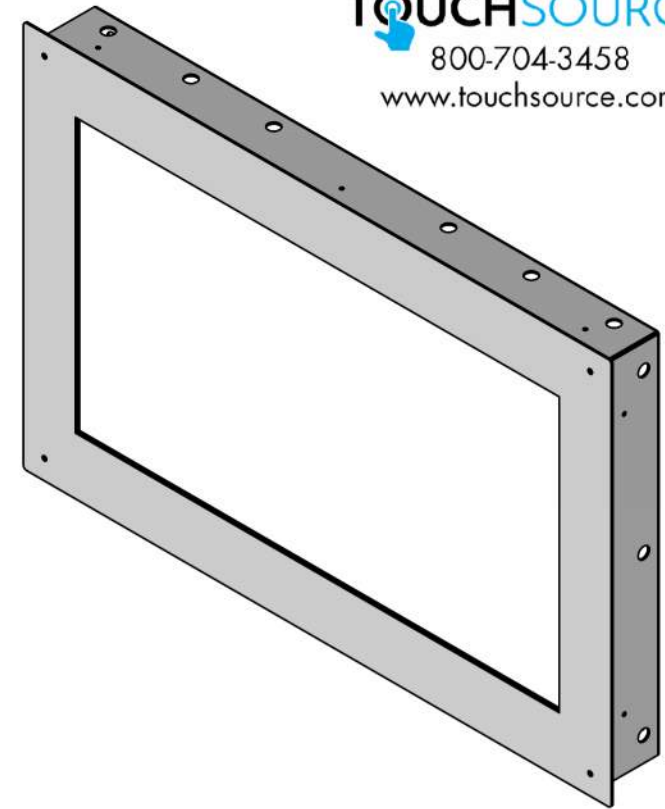
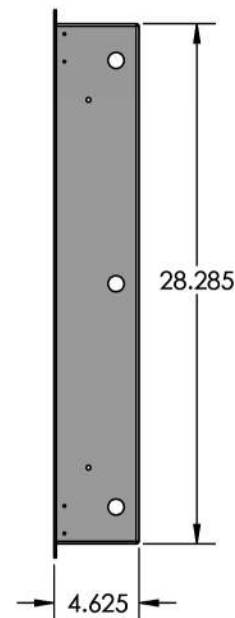
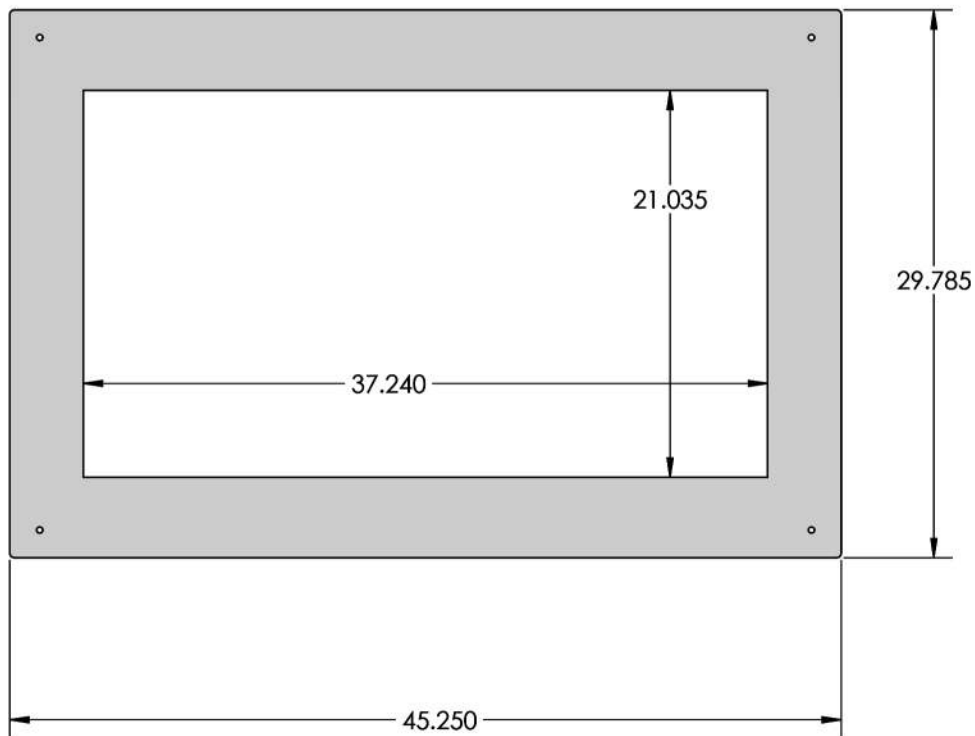
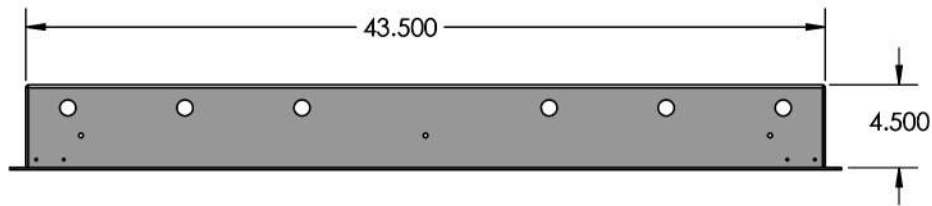
3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 15 00
VIDEO DISPLAY SYSTEMS

CUT SHEETS ATTACHED



ROUGH OPENING: 43.75"W X 28.535"H x 4.75" D

ELECTRICAL: 120V / 1.1 AMPS REQUIRED. MC CABLE TO ELECTRICIAN-INSTALLED
DUPLEX INSIDE CABINET (DEDICATED CIRCUIT NOT NECESSARY)

DATA: CAT5 DATA CABLE WITH RJ-45 MALE CONNECTOR

SHIPPING WEIGHT (touchscreen): 231 lbs

SHIPPING WEIGHT (non-touch): 234 lbs

Shipped via LTL Freight.

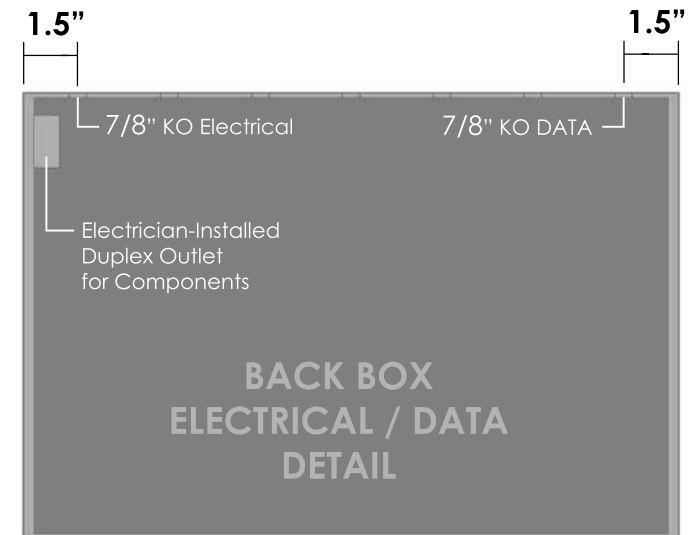
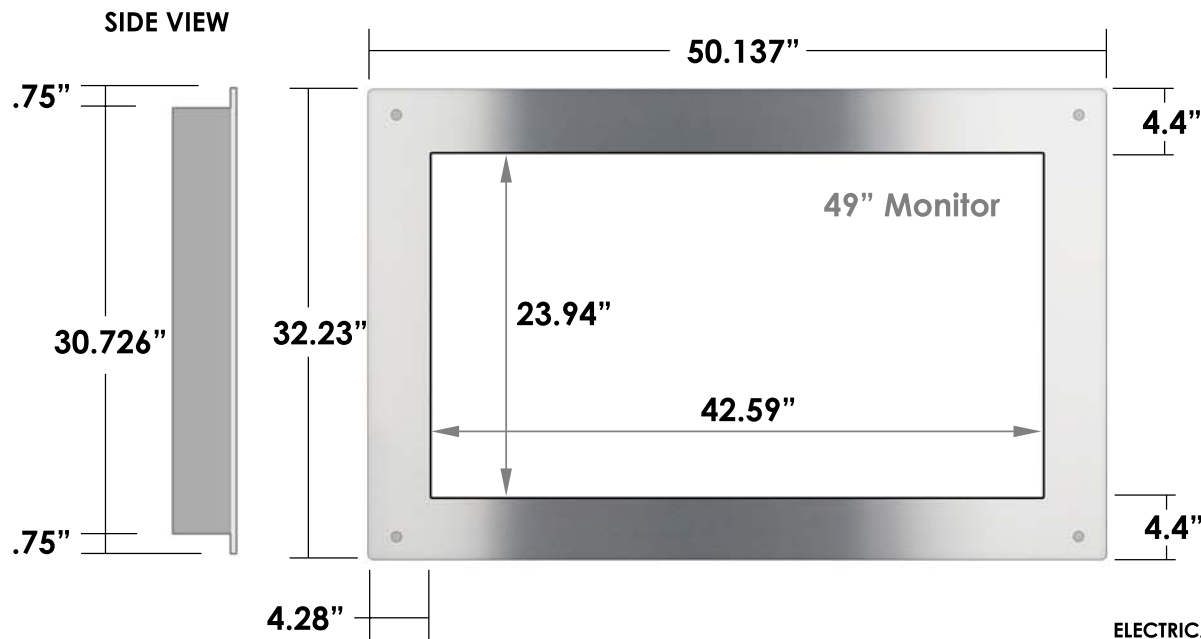
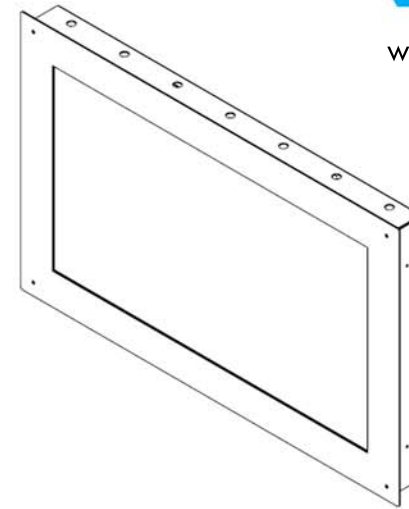
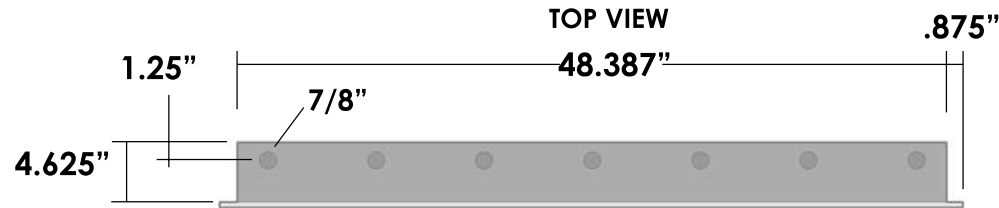
INSTALLED WEIGHT (touchscreen): 101 lbs

INSTALLED WEIGHT (non-touch): 104 lbs



800-704-3458

www.touchsource.com



ELECTRICAL: 120V / 1.2 AMPS REQUIRED. MC CABLE TO ELECTRICIAN-INSTALLED DUPLEX INSIDE CABINET (DEDICATED CIRCUIT NOT NECESSARY)

DATA: CAT5 DATA CABLE WITH RJ-45 MALE CONNECTOR

ROUGH OPENING: 48.65"W X 31"H X 4.75"D

NOTE: Cabinets subject to change, verify dimensions before modifying walls or structures.

MRR-49H

SHIPPING WEIGHT (touchscreen): 243 lbs

SHIPPING WEIGHT (non-touch): 216 lbs

Shipped via LTL Freight.

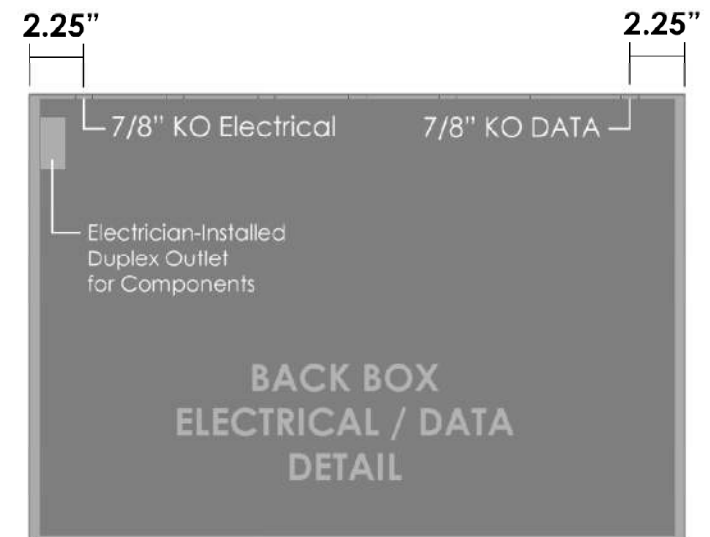
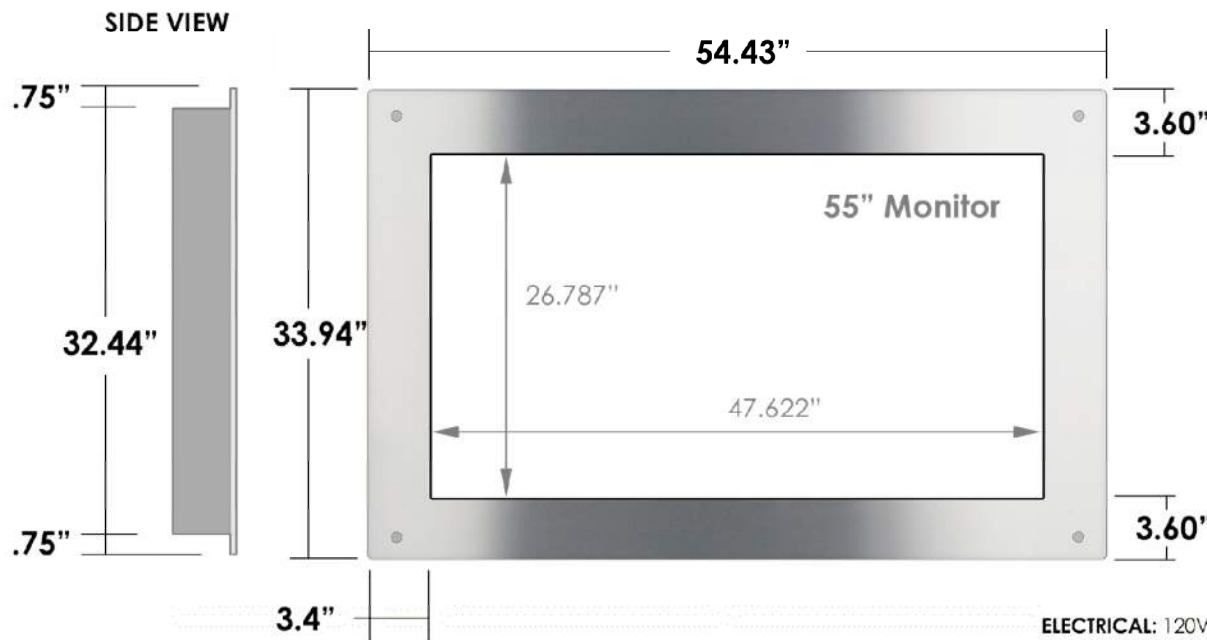
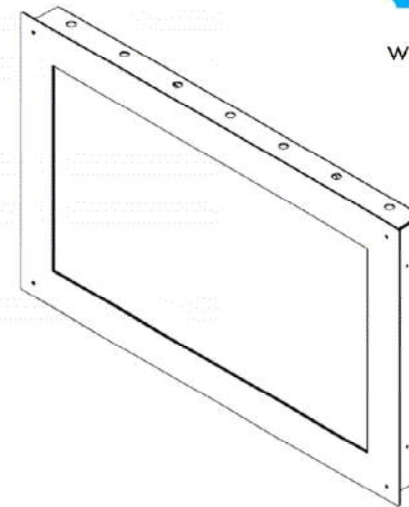
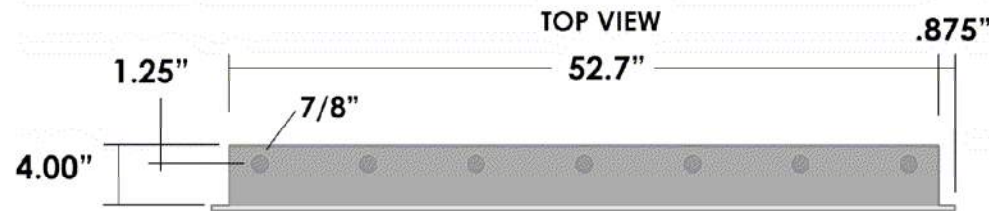
INSTALLED WEIGHT (touchscreen): 116 lbs

INSTALLED WEIGHT (non-touch): 89 lbs



800-704-3458

www.touchsource.com



ELECTRICAL: 120V / 1.6 AMPS REQUIRED. MC CABLE TO ELECTRICIAN-INSTALLED DUPLEX INSIDE CABINET (DEDICATED CIRCUIT NOT NECESSARY)

DATA: CAT5 DATA CABLE WITH RJ-45 MALE CONNECTOR

ROUGH OPENING: 53" W X 32.75" H X 4.125" D

NOTE: Cabinets subject to change, verify dimensions before modifying walls or structures.

MRR-55H

SECTION 10 21 13.13
METAL TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal toilet compartments.

1.02 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, door swings.
- C. Product Data: Provide data on panel construction, hardware, and accessories.
- D. Samples: Submit two samples of partition panels, 6x6 inch in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Toilet Compartments:
 - 1. All American Metal Corp - AAMCO: www.allamericanmetal.com/#sle.
 - 2. General Partitions Mfg. Corp: www.generalpartitions.com/#sle.
 - 3. Global Steel Products Corp: www.globalpartitions.com/#sle.
 - 4. Metpar Corp: www.metpar.com/#sle.
 - 5. Bradley, Series 400 - Sentinel.
 - 6. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Stainless Steel Sheet: ASTM A666, Type 304.

2.03 COMPONENTS

- A. Toilet Compartments: Stainless steel, floor-mounted headrail-braced.
- B. Doors, Panels, and Pilasters: Sheet steel faces, pressure bonded to sound deadening core, formed and closed edges; corners made with corner clips or mitered, welded, and ground smooth.
 - 1. Panel Faces: 20 gage, 0.0359 inch.
 - 2. Door Faces: 22 gage, 0.0299 inch.
 - 3. Pilaster Faces: 20 gage, 0.0359 inch.
 - 4. Reinforcement: 12 gage, 0.1046 inch.
 - 5. Internal Reinforcement: Provide in areas of attached hardware and fittings. Mark locations of reinforcement for partition mounted washroom accessories.
- C. Door and Panel Dimensions:
 - 1. Thickness: 1 inch.
 - 2. Door Width: 24 inch.
 - 3. Door Width for Handicapped Use: 36 inch, out-swinging.
 - 4. Height: 58 inch.
- D. Pilasters: 1-1/4 inch thick, of sizes required to suit compartment width and spacing.

2.04 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Hollow stainless steel tube, 1 by 1-5/8 inch size, with anti-grip strips and cast socket wall brackets.
- C. Brackets: Polished stainless steel.
- D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- E. Hardware: Polished stainless steel:
 - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 - 2. Nylon bearings.
 - 3. Thumb turn or sliding door latch with exterior emergency access feature.
 - 4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - 5. Coat hook with rubber bumper; one per compartment, mounted on door.
 - 6. Provide door pull for outswinging doors.

2.05 FINISHING

- A. Stainless Steel Compartments: No. 4 finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that field measurements are as indicated.
- C. Verify correct spacing of and between plumbing fixtures.
- D. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged enamel finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 26 00
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Protective wall covering.

1.02 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010.
- B. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2014.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2014.
- E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.
- D. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Maintenance Data: For each type of product. Include information regarding recommended and potentially detrimental cleaning materials and methods.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in conformance with manufacturer's recommendations for each type of item.
- E. Store products in either horizontal or vertical position, in conformance with manufacturer's instructions.

1.05 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Protective Wall Covering:
 - 1. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - 2. Inpro: www.inprocorp.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for conformance to applicable provisions of ASTM D256 and/or ASTM F476.
- B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance conforming to applicable provisions of ASTM D543.
- C. Fungal Resistance: Unless otherwise noted, provide protection products and assemblies which pass ASTM G21 testing.

2.03 PRODUCT TYPES

- A. Protective Wall Covering:
 - 1. Material: Polyethylene terephthalate (PET or PETG); PVC and PBTs-free.
 - 2. Thickness: 0.040 inch.
 - 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 4. Color: As selected from manufacturer's standard colors.
 - 5. Pattern: None.
 - 6. Texture: Suede.
 - 7. Accessories: Provide manufacturer's standard color-matched trim and moldings.
 - a. Inside Corner Trim: Standard angle
 - b. Outside Corner Trim: Standard angle.
 - 8. Mounting: Adhesive.
- B. Adhesives and Primers: As recommended by manufacturer.

2.04 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Form end trim closure by capping and finishing smooth.

2.05 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
 - 1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.
- D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position protective wall covering no less than 1 inch above finished floor to allow for floor level variation.
 - 1. Wainscot Installation: Establish a level line at the specified height for entire length of run. Install by aligning top of edge of covering with this line.
 - 2. Apply adhesive with 1/8 inch V-notch trowel to an area of wall surface that can be completed within cure time of the adhesive.

3. Install trim pieces as required for a complete installation. Allow tolerance for thermal movement.
4. At joints indicated to be caulked, allow for a minimum 1/16 inch wide gap between edges of sheets. Gaps are required to be of consistent width throughout the project.
5. Use a roller to ensure maximum contact with adhesive.
6. At inside and outside corners cut covering sheets to facilitate installation of trim pieces or corner guards.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Diaper changing stations.
- D. Utility room accessories.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- D. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2011.
- E. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- G. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004 (Reapproved 2010).
- H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. AJW Architectural Products: www.ajw.com.
 - 2. American Specialties, Inc: www.americanspecialties.com.
 - 3. Bradley Corporation: www.bradleycorp.com.
 - 4. Georgia-Pacific Professional: www.blue-connect.com/#sle.
 - 5. American Accessories Inc.; www.aaiusaonline.com.
- B. Diaper Changing Stations:
 - 1. American Specialties, Inc: www.americanspecialties.com/#sle.
 - 2. Bradley Corporation: www.bradleycorp.com/#sle.
 - 3. Diaper Deck & Company: www.diaperdeck.com/#sle.
 - 4. Koala Kare Products: www.koalabear.com/#sle.
 - 5. Safe-Strap Company, Inc: www.diaperdepot.com/#sle.
- C. Provide products of each category type by single manufacturer.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Keys: Provide two keys for each accessory to Owner; master key lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- F. Adhesive: Two component epoxy type, waterproof.
- G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, stainless steel, spindleless type for tension spring delivery designed to prevent theft of tissue roll.
- B. Paper Towel Dispenser: Electric, roll paper type.
 - 1. Cover: Stainless steel.
 - 2. Paper Discharge: Touchless automatic.
 - 3. Capacity: 6 inch diameter roll.
 - 4. Mounting: Semi recessed.
 - 5. Power: Battery operated.
 - 6. Refill Indicator: Illuminated refill indicator.
 - 7. Products:
 - a. Georgia-Pacific Professional; GP enMotion Stainless Recessed Automated Touchless Towel Dispenser: www.blue-connect.com/#sle.
- C. Recessed Convertible Automatic, Universal Roll Towel Dispenser/Waste Receptacle
 - 1. Convertible automatic universal, roll paper towel dispenser and 12-gal. waste receptacle module can be interchanged with a universal, touchfree module or a folded towel module and 18-gal. waste receptacle, respectively. Cabinet is not replaced when changing modules. Satin-finish stainless steel. Seamless beveled flange. Removable waste receptacle is locked into cabinet. Receptacle is 8" (205mm) deep with a capacity of 12-gal. (45.5L); extends 4 1/8" (105mm) from wall. Rough wall opening 16" W, 54 3/4" H, 4" min. depth (405 x 1390 x 100mm). Battery requirements: 4 Alkaline D Cells (not included).
 - 2. Product: B-3974, Classic Series by Bobrick
- D. Automated Soap Dispenser: Soap lather dispenser, wall-mounted, with stainless steel cover and window to gauge soap level, tumbler lock.
 - 1. Minimum Capacity: 48 ounces.
 - 2. Products:
 - a. Georgia-Pacific Professional; GP enMotion Brushed Stainless Automated Touchless Soap and Sanitizer Dispenser: www.blue-connect.com/#sle.
- E. Air Freshener Dispenser: Wall-mounted, battery operated.
 - 1. Products:
 - a. Georgia-Pacific Professional; GP ActiveAire Brushed Stainless Powered Whole-Room Freshener Dispenser: www.blue-connect.com/#sle.
- F. Mirrors: Stainless steel framed, 1/4 inch thick tempered safety glass; ASTM C1048.
 - 1. Size: 24x36.

2. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
 3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
- G. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base, tumbler lock.
1. Minimum capacity: 250 seat covers.
 2. Products:
 - a. Georgia-Pacific Professional; GP Safe-T-Gard Chrome 1/2 Fold Seatcover Dispenser: www.blue-connect.com/#sle.
 3. Satin-finish stainless steel
- H. Grab Bars: Stainless steel, smooth surface.
1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, concealed exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Length and Configuration: As indicated on drawings.
 - d. Products:
 - 1) B-5806 by Bobrick.
- I. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
1. Satin-finish stainless steel

2.05 OTHER ACCESSORIES

- A. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.06 DIAPER CHANGING STATIONS

- A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
1. Material: Polyethylene.
 2. Mounting: Surface.
 3. Color: Gray.
 4. Minimum Rated Load: 250 pounds.

2.07 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
1. Drying rod: Stainless steel, 1/4 inch diameter.
 2. Hooks: Two, 0.06 inch stainless steel rag hooks at shelf front.
 3. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
 4. Length: 36 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.
- D. See Section 061000 for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.

- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
 - 1. Grab Bars: As indicated on the drawings. (34-1/2" to center of bar above floor)
 - 2. Mirrors: 40 inch, measured from floor to bottom of mirrored surface.
 - 3. Other Accessories: As indicated on drawings.

END OF SECTION

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2013a.
- B. FM (AG) - FM Approval Guide; current edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.
- D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

1.04 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Ansul, a Tyco Business; Cleanguard: www.ansul.com/#sle.
 - 2. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - 3. Nystrom, Inc: www.nystrom.com/#sle.
 - 4. Oval Brand Fire Products; Oval Dry Chemical Fire Extinguisher - Multipurpose ABC: www.ovalfireproducts.com/#sle.
 - 5. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Activar Construction Products Group - JL Industries: www.activarcpg.com/#sle.
 - 2. Ansul, a Tyco Business: www.ansul.com/#sle.
 - 3. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - 4. Larsen's Manufacturing Co; _____: www.larsensmfg.com/#sle.
 - 5. Nystrom, Inc: www.nystrom.com/#sle.
 - 6. Oval Brand Fire Products; Cabinets for Low Profile Extinguishers: www.ovalfireproducts.com/#sle.
 - 7. Potter-Roemer: www.potterroemer.com/#sle.
 - 8. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.
 - 9. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

2. Refer to Fire Protection Drawings for additional list of extinguisher types required in Mechanical/Electrical spaces.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 1. Class: A:B:C type.
 2. Size: 10 pound.
 3. Finish: Baked polyester powder coat, color as selected.
 4. Temperature range: Minus 40 degrees F to 120 degrees F.
- C. Carbon Dioxide Type Fire Extinguishers: Aluminum tank, with pressure gauge.
 1. Class: B:C type.
 2. Size: 5 pound.
 3. Finish: Baked enamel, color as selected.
 4. Temperature range: Minus 40 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Non-fire rated.
 1. Formed primed steel sheet; 0.036 inch thick base metal.
- C. Fire Rated Cabinet Construction: One-hour fire rated.
 1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- D. Cabinet Configuration: Recessed type.
 1. Size to accommodate accessories.
 2. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.
- F. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.
- G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- H. Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: Baked enamel, color as selected.
- J. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Graphic Identification: Equal to Brady model #45368. "V" shaped projecting signage, 5-1/2 inches tall by 10 inches wide..

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 30 inches from finished floor to inside bottom of cabinet.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets.

E. Position cabinet signage at 84" above finished floor.

END OF SECTION

SECTION 10 55 00
POSTAL SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Central mail delivery boxes.

1.02 REFERENCE STANDARDS

- A. 39 CFR 111 - U.S. Postal Service Standard 4C; effective date September 3, 2006.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, maintenance information, and current USPS approval documentation.
- C. Shop Drawings: Indicate plans for each unit or groups of units, front elevations with compartment layout and model number, overall dimensions, rough-in opening sizes, construction and anchorage details.

1.04 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty against defects in materials or workmanship for a period of 5 years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 CENTRAL MAIL DELIVERY BOXES

- A. Manufacturers:
 - 1. Florence Manufacturing Company: www.florencemailboxes.com/#sle.
 - 2. Jensen Mailboxes: www.jensenmailboxes.com/#sle.
 - 3. Postal Products Unlimited, Inc: www.postalproducts.com/#sle.
 - 4. Salsbury Industries: www.mailboxes.com/#sle.
 - 5. Security Manufacturing Corp: www.securitymanufacturing.com/#sle.
- B. Central Mail Delivery Boxes: Provide products approved for United States Postal Service (USPS) delivery.
 - 1. Materials: Aluminum with stainless steel hardware.
 - 2. Finish: Powder coat in color selected by Architect from manufacturer's standard colors.
 - 3. Unit Types and Sizes: As indicated on drawings.
 - 4. Configurations: See drawings for overall dimensions and layouts.
- C. Wall-Mounted Mailboxes: Fully-recessed, complying with 39 CFR 111 (USPS-STD-4C).
 - 1. Unit A: Front-loading with master door, single-column design, 10 customer compartments, 1 outgoing mail compartment, and 2 parcel compartment.
 - a. Florence Manufacturing Company; Model 4CADD-10.

2.02 COMPONENTS

- A. Locking - Front Loading Master Door: Three-point latching mechanism with USPS master lock furnished and installed by postmaster.
- B. Locking - Customer Compartment Doors: USPS approved cam lock, 3 keys each lock.
- C. Locking - Parcel Compartment Doors: Double-lock arrangement with USPS approved cam lock for customer access, and USPS master lock furnished and installed by postmaster.
- D. Identification - Customer and Parcel Compartments: Sequential numerical or alphabetic characters, top to bottom, left to right; factory-installed.
 - 1. Engraved characters, 3/4 inch high, with black fill.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough-openings are ready to receive wall-mounted units.
- B. Do not begin installation until unacceptable conditions are corrected.

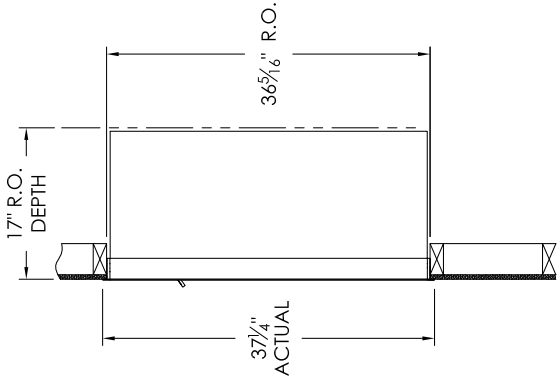
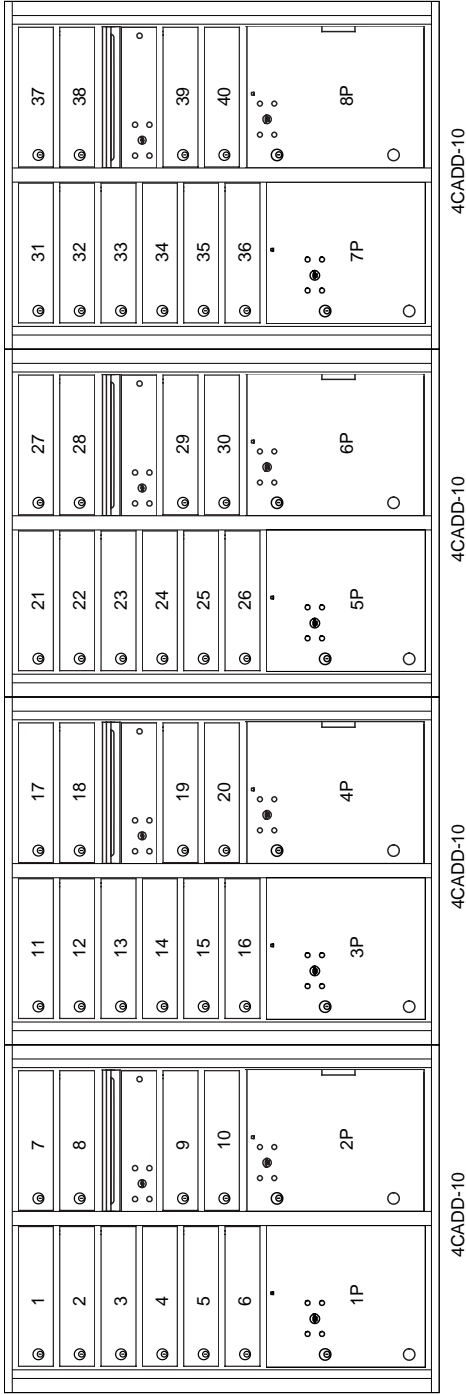
3.02 INSTALLATION

- A. Install postal specialties in accordance with approved shop drawings, manufacturer's instructions, and USPS requirements.
- B. Adjust and lubricate door hardware to operate properly.

END OF SECTION

Elevation 1 Dimensions
Overall Width: 10' 6-1/4"
(Rough Opening: 10' 5-1/8")

Side View



- 1. Models Used:** (4)4CADD-10
- 2. Installation:** recessed
- 3. 4C Finish:** Silver Speck
- 4. Locks:** Standard
- 5. Door Id:** Engraved_with_Black_Color_Fill, **Font:** US Block
Door identification should be approved by the local postal service.
- 6. Matching Standard Attached Trim**

Florence versatile™ 4C Mailbox Suites

Florence 4C mailboxes are USPS approved.
Your installation/layout must also meet a 1:10
parcel locker to mailbox ratio and installation
requirements (see next page) if serviced by
the U.S. Postal Service. Please contact your
local Post Office® if you have any
compliance questions re: your specific
project.

4C DOOR SIZES

- 1 High tenant:** 3" H x 12" W
- 4 High parcel:** 13-1/2" H x 12" W
- 1 High outgoing:** 6-1/2" H x 12" W
- 15 inch high parcel:** 15" H x 12" W

ELEVATION: Elevation 1 | **MAILBOXES:** 40 | **PARCELS:** 8

ARCHITECT: HD Architects

PROJECT NAME: Lees Summit MOB

FLORENCE
CORPORATION

5935 Corporate Drive • Manhattan, KS 66503
www.florencemailboxes.com • 800.275.1747

A CIBALUAR INDUSTRIES COMPANY

DRAWN BY:

P.O. NO:

QUOTE NO:

SHEET 1 OF 3

DATE: 10-22-2018

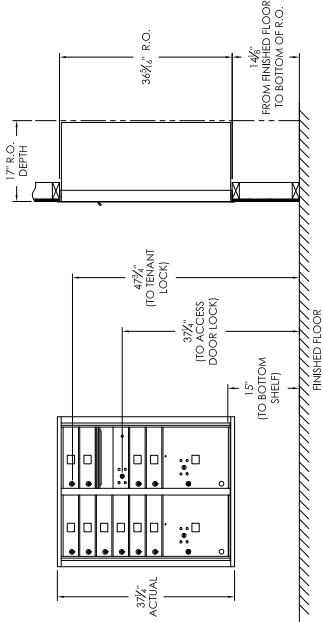
SCALE: NONE

DRAWING NO. WEB-92082

DO NOT SCALE OFF DRAWING

Sample Installation Dimensions

Elevation 1 - 4CAD



Installation Requirements

The drawings shown above represent minimum installation requirements for 4C installation. Dimensions shown are simply for reference purposes. Installers should use the following guidelines when installing for USPS mail delivery (private delivery installs should follow these rules for accessibility, but are not required.)

1. At least one customer compartment shall be positioned less than 48 inches above the finished floor.
2. No parcel locker compartment (interior bottom shelf) shall be positioned less than 15 inches above the finished floor.
3. No customer lock shall be located more than 67 inches above the finished floor.
4. No customer compartment (interior bottom shelf) shall be positioned less than 28 inches above the finished floor.
5. The USPS Arrow lock shall be located between 36 and 48 inches above the finished floor.

ELEVATION: Installation Drawings	
ARCHITECT: HD Architects	
PROJECT NAME: Lees Summit MOB	
DRAWN BY:	
DATE: 10-22-2018	P.O. NO:
SCALE: NONE	QUOTE NO:
DRAWING NO. WEB-92082	SHEET 2 OF 3

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Configuration Summary

PROJECT NAME: Lees Summit MOB
PRODUCT TYPE: 4C
INSTALLATION: recessed

4C MODELS USED: (4)4CADD-10
TOTAL MAILBOXES: 40
TOTAL PARCELS: 8

COLOR: Silver Speck
LOCK TYPE: Standard
DOOR IDENTIFICATION: Engraved_with_Black_Color_Fill

DELIVERY MODE: usps
ADA COMPLIANCE: 100% with ADA Reach Ranges

The information above represents the totals for the entire project, across all elevations.

ELEVATION: Configuration Summary			
ARCHITECT: HD Architects			
PROJECT NAME: Lees Summit MOB		DRAWN BY:	
<div>FLORENCE CORPORATION</div> <div>5935 Corporate Drive • Manhattan, KS 66503</div> <div>www.florencemailboxes.com • 800.275.1747</div> <div>A GIBBALTAR INDUSTRIES COMPANY</div>	DATE: 10-22-2018	P.O. NO:	
	SCALE: NONE	QUOTE NO:	
	DRAWING NO. WEB-92082	SHEET 3 OF 3	

SECTION 10 71 13.43
FIXED SUN SCREENS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Modular, shop fabricated, extruded aluminum sun screens to be mounted on structure provided by others.

1.02 RELATED REQUIREMENTS

- A. Section 08 43 13 - Aluminum-Framed Storefronts: Mounting substrates.

1.03 REFERENCE STANDARDS

- A. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
- B. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- G. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2013a.

1.04 SUBMITTALS

- A. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing all profiles, sections of all components, finishes, fastening details, and manufacturer's technical and descriptive data. Include field dimensions of openings and elevations on shop drawings.
- B. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Perform structural design under direct supervision of a Professional Engineer experienced in design of this type of work licensed in Missouri.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site ready for erection.
- B. Package using methods that prevent damage during shipping and storage on site.
- C. Store materials under cover and elevated above grade.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Sun Screens: Correct defective work within a one year period after Date of Substantial Completion.
- C. Finish Warranty: Provide manufacturer's one year warranty on factory finish against cracking, peeling, and blistering.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fixed Sun Screens:
 - 1. Same manufacturer as storefront to which sun screens are to be attached.

2.02 SUN SCREENS

- A. Sun Screens: Shop fabricated, shop finished, extruded aluminum outriggers, louvers, and fascia, free of defects impairing strength, durability or appearance.
 - 1. Configuration: As indicated on drawings.
 - 2. Louver Type: Pipe.
 - 3. Outrigger Shape: Straight.
 - 4. Sizes: As indicated on drawings.
 - 5. Exposed Aluminum Finish: Match Aluminum-Framed Storefront framing, refer to section for finish information.
 - 6. Provide a complete system ready for erection at project site.
 - 7. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.

2.03 MATERIALS

- A. Aluminum Extrusions: ASTM B209 (ASTM B209M) or ASTM B221 (ASTM B221M).
- B. Aluminum Coated Steel Sheet: ASTM A792/A792M.
- C. Concealed Structural Supports: Aluminum, or steel coated for corrosion resistance and dissimilar metal isolation.
- D. Fasteners: ASTM F593 stainless steel or ASTM A307 carbon steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and site area for conditions that might prevent satisfactory installation.
- B. Verify that dimensions of supporting structure are within plus/minus 1/8 inch of dimensions indicated on shop drawings.
- C. Verify that all adjacent painting, roofing, masonry work, and other work that might damage sun screen finish has been completed prior to installation of sun screens.
- D. Do not install until after all adjacent painting, roofing and masonry have been completed.
- E. Do not proceed with installation until all conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. Set units level, plumb, with uniform joints, and aligned with building elements.
- C. Separate dissimilar metals using concealed bituminous paint or non-absorbent gasket.
- D. Anchor units to structure as indicated on drawings.
- E. Do not cut or trim aluminum members without approval of manufacturer; do not install damaged members.

3.03 TOLERANCES

- A. Maximum Variation from Level: Plus/Minus 1/8 inch.

END OF SECTION

SECTION 12 36 61
SIMULATED STONE COUNTERTOPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Quartz agglomerate countertops and backsplashes.
- B. Related Sections:
 - 1. Section 079200 "Joint Sealants" for sealing gaps between countertops and building components.
 - 2. Division 22 "Plumbing Fixtures and Trim" for [nonintegral sinks] [sinks] [and] [plumbing fittings].

1.03 ACTION SUBMITTALS

- A. Product Data: For countertop materials and integral sinks.
- B. Shop Drawings: For countertops. Show materials, finishes, edge, and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.
 - 2. Wood trim, 8 inches long.
 - 3. One full-size solid-surface-material countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.
 - 4. One full-size quartz agglomerate countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.04 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements [after base cabinets are installed but] before countertop fabrication is complete.

1.05 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 PRODUCTS

2.01 QUARTZ AGGLOMERATE COUNTERTOPS

- A. Configuration: Provide countertops with the following front and backsplash style:
 - 1. Front: Beveled.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. Endsplash: Matching backsplash.
- B. Countertops: 3/4-inch thick, quartz agglomerate with front edge built up with same material.
- C. Backsplashes: 3/4-inch thick, quartz agglomerate .

2.02 COUNTERTOP MATERIALS

- A. Particleboard: ANSI A208.1, Grade M-2.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
- C. Adhesives: Adhesives shall not contain urea formaldehyde.
- D. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Caesarstone International.
 - b. Cambria
 - c. Cosentino USA.
 - d. E. I. du Pont de Nemours and Company.
 - e. LG Chemical, Ltd.
 - f. Meganite Inc.
 - g. Samsung Chemical USA, Inc.
 - h. Technistone USA, Inc.
 - i. Transolid, Inc.
2. Manufacturers: Subject to compliance with requirements, provide products by manufacturers listed in Document 002150 - Owner's Preferred Vendor List.
3. Colors and Patterns: As shown on Drawings.

2.03 ACCESSORIES

- A. Grommets for Cable Passage through Countertops: Doug Mockett and Company as follows:
 1. EDP3 Flip-Top Series 2-1/2 inch Grommet.
 2. RG Rectangular Grommet.
- B. Keyboard Trays: Provide one of the following:
 1. No. H2133-22 by WorkRite Ergonomic Accessories, Inc. as follows:
 - a. Support arms: "Pinnacle" No. 2170-22TG adjustable arm.
 - b. Tray platforms: "Banana Board" Model UB2180S-25 keyboard platform with No. 2120-25 mouse support and black palm support.
 - c. No. 84342131 by CompX ErgonomX as follows:
 - 1) Support arms: "Ovation" No. 8434D adjustable arm with 21" track.
 - 2) Tray platforms: "Harmony" No. 6531D with mouse support and palm support.
- C. Support Brackets: Hafele No. 287.44.461 – Hebgo bracket.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- C. Seal edges of cutouts in particleboard subtops by saturating with varnish.

END OF SECTION

SECTION 14 21 00
ELECTRIC TRACTION ELEVATORS (MRL)

GENERAL

1.01 SUMMARY

- A. Section Includes: Electric Traction Elevators.
- B. Products Supplied But Not Installed Under this Section:
 - 1. Hoist Beam
 - 2. Pit Ladder
 - 3. Inserts mounted in block walls for rail attachments
- C. Work Supplied Under Other Sections:
 - 1. Temporary lighting, including temporary lighting in hoistway for machine space with switch located in hoistway on the strike jamb side of top landing door.
 - 2. Main line disconnects for each elevator.
 - a. One fused three phase permanent power in building electrical distribution room
 - 3. Hoistway ventilation shall be in accordance with local and national building code requirements.
 - 4. Guide Rail Support shall be structurally adequate to extend from pit floor to top of hoistway, with spans in accordance with requirements of authority having jurisdiction and final layouts.
 - 5. Removable barricades at all hoistway openings, in compliance with OSHA 29 CFR 1926.502 in addition to any local code requirements.
 - 6. Lifeline attachments capable of withstanding 5000 lb load in accordance with OSHA 29 CFR 1926.502. Provide a minimum of 2 at the top, front of each hoistway.
 - 7. Pit lighting: Fixture with switch and guards. Provide illumination level equal to or greater than that required by ASME A17.1/CSA B44 2000, or applicable version.
 - 8. Control space lighting with switch. Coordinate switch with lighting for machine space as allowable by code.
 - 9. Access Doors: As required for access to governor. Access door shall be self-closing, self-locking if necessary and operable from the inside without a key.
- D. Elevator controls shall be non-proprietary software for Client use.

1.02 INDUSTRY AND GOVERNMENT STANDARDS:

- A. ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities
- B. ADAAG - Accessibility Guidelines for Buildings and Facilities
- C. ANSI/NFPA 70, National Electrical Code
- D. ANSI/NFPA 80, Standard for Fire Doors and Fire Windows
- E. ASME/ANSI A17.1, Safety Code for Elevators and Escalators.

1.03 DESCRIPTION OF ELEVATOR

- A. Elevator Equipment: MonoSpace® 500 gearless traction elevator
- B. Equipment Control: KCM831
- C. Drive: Non-Regenerative
- D. Quantity of Elevators: 2
- E. Landings: 3
- F. Openings: 3 Front Openings, 0 Back Openings
- G. Travel: 30'-0"
- H. Rated Capacity: 2500 lb IBC
- I. Rated Speed: 150 fpm
- J. Clear Inside Dimensions (W x D): 6' 11" x 4' 4"

- K. Cab Height: 8' 0"
- L. Clear height under suspended ceiling: 7' 6"
- M. Entrance Width and Type: 3' 6" and Right/Left Openings
- N. Entrance Height: 7' 0"
- O. Main Power Supply: 480 Volts + 5%, three-phase
- P. Operation: Duplex
- Q. Machine Location: Inside the hoistway mounted on car guide rail
- R. Control Space Location: Integrated Control System (ICS)
- S. Elevator Equipment shall conform to the requirements of seismic zone: non-seismic
- T. Maintenance Service Period: 12

1.04 PERFORMANCE REQUIREMENTS

- A. Car Performance
 - 1. Car Speed \pm 5% of contract speed under any loading condition or direction of travel.
 - 2. Car Capacity: Safely lower, stop and hold (per code) up to 125% of rated load.
- B. System Performance
 - 1. Vertical Vibration (maximum): 15 mg ISO187338/ISO 8041 system pk -pk
 - 2. Horizontal Vibration (maximum): 12 mg ISO187338/ISO 8041 system pk -pk
 - 3. Jerk Rate (maximum): 3.3 ft/sec³
 - 4. Acceleration (maximum) 1.3 ft/sec²
 - 5. In Car Noise: = 55 dB(A)
 - 6. Leveling Accuracy: \pm 0.2 inches
 - 7. Starts per hour (maximum): 180

1.05 SUBMITTALS

- A. Comply with Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit manufacturer's product literature for each proposed system.
 - 1. Cab design, dimensions and layout.
 - 2. Layout, finishes, and accessories and available options.
 - 3. Controls, signals and operating system.
 - 4. Color selection charts for cab and entrances.
- C. Shop Drawings:
 - 1. Clearances and travel of car.
 - 2. Clear inside hoistway and pit dimensions.
 - 3. Location and layout of equipment and signals.
 - 4. Car, guide rails, buffers and other components in hoistway.
 - 5. Maximum rail bracket spacing.
 - 6. Maximum loads imposed on building structure.
 - 7. Hoist beam requirements.
 - 8. Location and sizes of access doors.
 - 9. Location and details of hoistway door and frames.
 - 10. Electrical characteristics and connection requirements.
- D. Operation and maintenance data:
 - 1. Provide manufacturer's standard maintenance and operation manual.
- E. Diagnostic Tools
 - 1. Prior to seeking final acceptance for the completed project as specified by the Contract Documents, the Elevator Contractor shall deliver to the Owner any specialized tool(s) that may be required to perform diagnostic evaluations, adjustments, and/or parametric software changes and/or test and inspections on any piece of control or monitoring equipment installed. This shall include any specialized tool(s) required for monitoring, inspection and/or maintenance where the means of suspension other than conventional

wire ropes are furnished and installed by the Elevator Contractor. Any and all such tool(s) shall become property of the Owner. Any diagnostic tool provided to the Owner by the Elevator Contractor shall be configured to perform all levels of diagnostics, systems adjustment and parametric software changes which are available to the Elevator Contractor. In those cases where diagnostic tools provided to the Owner require periodic recalibration/or re-initiation, the Elevator Contractor shall perform such tasks at no additional cost to the Owner for a period equal to the term of the maintenance agreement from the date of final acceptance of the completed project. During those intervals in which the Owner might find it necessary to surrender a diagnostic tool for re-calibration, re-initiation, or repair, the Elevator Contractor shall provide a temporary replacement for the tool at no additional cost to the Owner. The Elevator Contractor shall deliver to the Owner, printed instructions for the proper use of any tool that may be necessary to perform diagnostic evaluations, system adjustment, and/or parametric software changes on any unit of microprocessor-based elevator control equipment and means of suspension other than standard elevator steel cables furnished and install by the Elevator Contractor. Accompanying the printed instructions shall be any and all access codes, password, or other proprietary information that is necessary to interface with the microprocessor-control equipment.

1.06 QUALITY ASSURANCE

- A. Manufacturer: Minimum of fifteen years experience in the fabrication, installation and service of elevators of the type and performance of the specified. The manufacturer shall have a documented quality assurance program.
- B. Installer: The equipment manufacturer shall install the elevator.
- C. Inspection and Testing: In accordance with requirements of local jurisdiction, obtain required permits, inspections and tests.

1.07 DELIVERY, STORAGE AND HANDLING

- A. If the construction site is not prepared to receive the elevator equipment at the agreed ship date, the General Contractor shall be responsible to provide a safe, dry, and easily accessible storage area on or off the premises. Additional labor costs for double handling will be the responsibility of the general contractor.
- B. Delivered elevator materials shall be stored in a protected environment in accordance with manufacturer recommendations. A minimum storage area of 10 feet by 20 feet is required adjacent to the hoistway.

1.08 WARRANTY

- A. Provide manufacturer warranty for a period of one year. The warranty period is to begin upon Substantial Completion of the Contract. Warranty covers defects in materials and workmanship. Damage due to ordinary use, vandalism, improper or insufficient maintenance, misuse, or neglect do not constitute defective material or workmanship.

1.09 MAINTENANCE SERVICE

- A. The elevator manufacturer shall provide maintenance service consisting of regular examinations and adjustments of the elevator equipment for a period of 12 after date of substantial completion. Replacement parts shall be produced by the original equipment manufacturer.
- B. Maintenance service be performed during regular working hours of regular working days and shall include regular time call back service.
- C. Maintenance service shall not include adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Provide AC gearless machine room-less elevator systems subject to compliance with the design and performance requirements of this specification. Elevator manufacturers may include but are not limited to one of the following:
 - 1. Basis of Design: MonoSpace® 500 traction elevators by KONE, Inc. (www.kone.com).
 - 2. Other acceptable machine room-less products: manufacturer with minimum 15 years experience in manufacturing, installing, and servicing elevators of the type required for the project.

2.02 EQUIPMENT: CONTROL COMPONENTS AND CONTROL SPACE

- A. Controller: Provide microcomputer based control system to perform all of the functions.
 - 1. All high voltage (110V or above) contact points inside the controller cabinet shall be protected from accidental contact in a situation where the controller doors are open.
 - 2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed and physically segregated from the rest of the controller.
 - 3. Provide a serial cardrack and main CPU board containing a non-erasable EPROM and operating system firmware.
 - 4. Variable field parameters and adjustments shall be contained in a non-volatile memory module.
- B. Drive: Provide Variable Voltage Variable Frequency AC drive system to develop high starting torque with low starting current.
- C. Controller Location: Locate controllers in the front wall integrated with the top landing entrance frame, machine side of the elevator. One non-fused three phase permanent power in hoist way at top landing. A separate control space should not be required.

2.03 EQUIPMENT: HOISTWAY COMPONENTS

- A. Machine: AC gearless machine, with permanent magnet synchronous motor, direct current electro-mechanical disc brakes and integral traction drive sheave, mounted to the car guide rail at the top of the hoistway.
- B. Governor: Friction type over-speed governor rated for the duty of the elevator specified.
- C. Buffers, Car and Counterweight: Polyurethane buffer.
- D. Hoistway Operating Devices:
 - 1. Emergency stop switch in the pit
 - 2. Terminal stopping switches.
 - 3. Emergency stop switch on the machine
- E. Positioning System: System consisting of magnets and proximity switches.
- F. Guide Rails and Attachments: Steel rails with brackets and fasteners.

2.04 EQUIPMENT: HOISTWAY ENTRANCES

- A. Hoistway Entrances
 - 1. Sills: Aluminum extruded.
 - 2. Doors: Hollow metal construction with vertical internal channel reinforcements.
 - 3. Fire Rating: Entrance and doors shall be UL fire-rated for 1-1/2 hour.
 - 4. Entrance Finish: Brushed Stainless Steel.
 - 5. Entrance Markings Jamb Plates: Provide standard entrance jamb tactile markings on both jambs, at all floors. Plate Mounting: Refer to manufacturer drawings.

2.05 EQUIPMENT: CAR COMPONENTS

- A. Car Frame: Provide car frame with adequate bracing to support the platform and car enclosure.
- B. Platform: Platform shall be all steel construction.

- C. Car Guides: Provide guide-shoes mounted to top and bottom of both car and counterweight frame. Each guide-shoe assembly shall be arranged to maintain constant contact on the rail surfaces. Provide retainers in areas with Seismic design requirements.
- D. Steel Cab Cool Vintage Standard - 42009
- E. Car Wall Finish:
 - 1. Rear Wall: Non-removable vertical panels Graphic Bamboo printed laminate.
 - 2. Side Walls: Non-removable vertical panels Pearl Silver laminate.
- F. Car Skirting Finish: Brushed Stainless Steel
- G. Car Front Finish: Brushed Stainless Steel
- H. Car Door Finish: Brushed Stainless Steel
- I. Ceiling: Rectangular LED light panel, Brushed Stainless Steel
- J. Handrail: Round, straight ends, Brushed Stainless Steel
 - 1. Rails to be located on Side Walls of car enclosure.
- K. Threshold: Aluminum
- L. Flooring: By others. (Not to exceed 6lb/sqft and 1/2" finished depth.)
- M. Emergency Car Signals
 - 1. Emergency Siren: Siren mounted on top of cab that is activated when the alarm button in the car operating panel is engaged. Siren shall have rated sound pressure level of 80 dB(A) at a distance of three feet from device. Siren shall respond with a delay of not more than one second after activation of alarm button.
 - 2. Emergency Car Lighting: Provide emergency power unit employing a 12-volt sealed rechargeable battery and totally static circuits shall illuminate the elevator car and provide current to the alarm bell in the event of building power failure.
 - 3. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.
- N. Ventilation: Fan

2.06 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

- A. Car Operating Panel: Provide car operating panel with all push buttons, key switches, and message indicators for elevator operation. Fixture finish to be: Brushed Stainless Steel
 - 1. Main Flush mounted car operating panel shall contain a bank of round, mechanical, illuminated buttons marked to correspond to landings served, emergency call button, door open button, door close button, and key switches for lights, inspection, and exhaust fan. Buttons have Blue illumination (halo). All buttons to have raised text and Braille marking on left hand side. The car operating display panel shall be Blue DOT-matrix. All texts, when illuminated, shall be Blue. The car operating panel shall have a Brushed Stainless Steel finish.
 - 2. Additional features of car operating panel shall include:
 - a. Car Position Indicator within operating panel (Blue).
 - b. Elevator Data Plate marked with elevator capacity and car number on car top.
 - c. Help buttons with raised markings.
 - d. In car stop switch per local code.
 - e. Call Cancel Button.
- B. Hall Fixtures: Wall mounted hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Wall mounted hall fixtures shall have a Brushed Stainless Steel.
 - 1. Hall fixtures shall feature round, mechanical, buttons in applied mount face frame. Hall fixtures shall correspond to options available from that landing. Buttons shall be in a vertically mounted fixture. Hall fixtures shall not be jambmounted. Hall lanterns shall feature Blue illumination.
- C. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the

direction in which the car is to travel and a chime will sound. The chime will sound once for up and twice for down. The car riding lantern face plate shall have a Brushed Stainless Steel finish

2.07 EQUIPMENT: ELEVATOR OPERATION AND CONTROLLER

- A. Elevator Operation
 - 1. Duplex Collective Operation (two cars): Using a microprocessor-based controller, the operation shall be automatic by means of the car and hall buttons. In the absence of system activity, one car can be made to park at the pre-selected main landing. The other car shall remain at the last landing served. Only one car shall respond to a hall call. If either car is removed from service, the other car shall immediately answer all hall calls, as well as its own car calls.
 - 2. Zoned Car Parking.
 - 3. Relative System Response Dispatching.
- B. Standard Operating Features to include:
 - 1. Full Collective Operation
 - 2. Fan and Light Control.
 - 3. Load Weighing Bypass.
 - 4. Ascending Car Uncontrolled Movement Protection
 - 5. Top of Car Inspection Station.
- C. Additional Operating Features to include:
 - 1. Provision for Card Reader in Car (Card Reader provided and Installed by others).
- D. Elevator Control System for Inspections and Emergency
 - 1. Provide devices within controller to run the elevator in inspection operation.
 - 2. Provide devices on car top to run the elevator in inspection operation.
 - 3. Provide within controller an emergency stop switch to disconnect power from the brake and prevents motor from running.
 - 4. Provide the means from the controller to mechanically lift and control the elevator brake to safely bring car to nearest available landing when power is interrupted.
 - 5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
 - 6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.
 - 7. Provide the means for the control to reset elevator earthquake operation.

2.08 EQUIPMENT: DOOR OPERATOR AND CONTROL

- A. Door Operator: A closed loop permanent magnet VVVF high-performance door operator shall be provided to open and close the car and hoistway doors simultaneously. Door movement shall be cushioned at both limits of travel. Electro-mechanical interlock shall be provided at each hoistway entrance to prevent operation of the elevator unless all doors are closed and locked. An electric contact shall be provided on the car at each car entrance to prevent the operation of the elevator unless the car door is closed.
- B. The door operator shall be arranged so that, in case of interruption or failure of electric power, the doors can be readily opened by hand from within the car, in accordance with applicable code. Emergency devices and keys for opening doors from the landing shall be provided as required by local code.
- C. Doors shall open automatically when the car has arrived at or is leveling at the respective landings. Doors shall close after a predetermined time interval or immediately upon pressing of a car button. A door open button shall be provided in the car. Momentary pressing of this button shall reopen the doors and reset the time interval.
- D. Door hangers and tracks shall be provided for each car and hoistway door. Tracks shall be contoured to match the hanger sheaves. The hangers shall be designed for power operation with provisions for vertical and lateral adjustment. Hanger sheaves shall have polyurethane tires and pre-lubricated sealed-for-life bearings.

- E. Electronic Door Safety Device. The elevator car shall be equipped with an electronic protective device extending the full height of the car. When activated, this sensor shall prevent the doors from closing or cause them to stop and reopen if they are in the process of closing. The doors shall remain open as long as the flow of traffic continues and shall close shortly after the last person passes through the door opening.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Field measure and examine substrates, supports, and other conditions under which elevator work is to be performed.
- B. Do not proceed with work until unsatisfactory conditions are corrected.
- C. Prior to start of Work, verify hoistway is in accordance with shop drawings. Dimensional tolerance of hoistway from shop drawings: -0 inches +2 inches. Do not begin work of this section until dimensions are within tolerances.
- D. Prior to start of Work, verify projections greater than 2 inches (4 inches if ASME A17.1/CSA B44 2000 applies) must be beveled not less than 75 degrees from horizontal.
- E. Prior to start of Work, verify landings have been prepared for entrance sill installation. Traditional sill angle or concrete sill support shall not be required.
- F. Prior to start of Work, verify elevator pit has been constructed in accordance with requirements, is dry and reinforced to sustain vertical forces, as indicated in approved submittal. Verify that sumps or sump pumps located within pit will not interfere with installed elevator equipment.
- G. Prior to start of Work, verify control space has been constructed in accordance with requirements, with access coordinated with elevator shop drawings, including Sleeves and penetrations.
- H. Verify installation of GFCI protected 20-amp in pit and adjacent to each signal control cabinet in control space.

3.02 PREPARATION

- A. Coordinate installation of anchors, bearing plates, brackets and other related accessories.

3.03 INSTALLATION

- A. Install equipment, guides, controls, car and accessories in accordance with manufacturer installation methods and recommended practices.
- B. Properly locate guide rails and related supports at locations in accordance with manufacturer's recommendations and approved shop drawings. Anchor to building structure using isolation system to minimize transmission of vibration to structure.
- C. All hoistway frames shall be securely fastened to fixing angles mounted in the hoistway. Coordinate installation of sills and frames with other trades.
- D. Lubricate operating system components in accordance with manufacturer recommendations.
- E. Perform final adjustments, and necessary service prior to substantial completion.

3.04 CONSTRUCTION

- A. Interface with Other Work:
 - 1. Guide rail brackets attached to steel shall be installed prior to application of fireproofing.
 - 2. Coordinate construction of entrance walls with installation of door frames and sills. Maintain front wall opening until elevator equipment has been installed.
 - a. Ensure adequate support for entrance attachment points at all landings.
 - b. Coordinate wall openings for hall push buttons, signal fixtures and sleeves. Each elevator requires sleeves within the hoistway wall.
 - c. Coordinate emergency power transfer switch and power change pending signals as required for termination at the primary elevator signal control cabinet in each group.
 - d. Coordinate interface of elevators and fire alarm system.

- e. Coordinate interface of dedicated telephone line.
- f. Coordinate the installation of the non fused three phase permanent power disconnect in hoist way at top landing

3.05 TESTING AND INSPECTIONS

- A. Perform recommended and required testing in accordance with authority having jurisdiction.
- B. Obtain required permits and provide originals to Owner's Representative.

3.06 DEMONSTRATION

- A. Prior to substantial completion, instruct Owner's Representative on the proper function and required daily maintenance of elevators. Instruct personnel on emergency procedures.

END OF SECTION

SECTION 21 05 00

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Sleeves.
 - 3. Escutcheons.
 - 4. Fire-suppression demolition.
 - 5. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

2.3 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.4 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.

2.5 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. The General Contractor must coordinate all systems and comply with the RAF shop drawings.
- B. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- C. 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 Coordination Drawings.

- 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. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. 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 unless dry seal threading is specified.
 - 2. 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.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service

application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

END OF SECTION

SECTION 21 11 00

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.
- B. Related Sections:
 - 1. Division 21 Section "Wet Pipe Sprinkler Systems" for wet-pipe fire-suppression sprinkler systems inside the building.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Detail pipe routing and indicate dimensions, method of field assembly, and components.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water.
 - 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 the "Approval Guide," published by FM Global, 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. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end.
- D. 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, Inc.
 - b. Shurjoint Piping Products.
 - c. Star Pipe Products.
 - d. 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.
- E. 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.
- F. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.
 - 1. Gaskets: AWWA C111, rubber.
- G. Flanges: ASME B16.1, Class 125, cast iron.

2.2 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Flexible Expansion 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. EBAA Iron, Inc.
 - b. ROMAC Industries Inc.
 - c. Star Pipe Products.
 - 2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 3. Pressure Rating: 250 psig minimum.

2.3 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: High-density, cross-laminated PE film of 0.004-inch minimum thickness.
- C. Form: tube.
- D. Color: natural.

2.4 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.

2.5 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.
- B. Tubular-Sleeve Pipe Couplings:
 - 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. Dresser, Inc.; Dresser Piping Specialties.
 - b. Ford Meter Box Company, Inc. (The); Pipe Products Division.
 - c. JCM Industries.
 - d. Viking Johnson.
 - 2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
 - 3. Standard: AWWA C219.
 - 4. Center-Sleeve Material: Manufacturer's standard.
 - 5. Gasket Material: Natural or synthetic rubber.
 - 6. Pressure Rating: 200 psig minimum.
 - 7. Metal Component Finish: Corrosion-resistant coating or material.

2.6 GATE VALVES

- A. UL-Listed or FM-Approved Gate 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. American Cast Iron Pipe Company; American Flow Control Division.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Mueller Co.; Water Products Division.
 - f. NIBCO INC.

- g. Tyco Fire & Building Products LP.
- 2. 175-psig, UL-Listed or FM-Approved, Iron, Nonrising-Stem Gate Valves:
 - a. Description: Iron body and bonnet, bronze seating material, and inside screw.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - c. Pressure Rating: 175 psig minimum.
 - d. End Connections: Mechanical or push-on joint.
 - e. Indicator-Post Flange: Include on valves used with indicator posts.
- 3. 175-psig, UL-Listed or FM-Approved, Iron, OS&Y, Gate Valves:
 - a. Description: Iron body and bonnet and bronze seating material.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - c. Pressure Rating: 175 psig minimum.
 - d. End Connections: Flanged or grooved.
- 4. UL-Listed or FM-Approved, OS&Y Bronze, Gate Valves:
 - 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) Crane Co.; Crane Valve Group; Crane Valves.
 - 2) Crane Co.; Crane Valve Group; Stockham Division.
 - 3) NIBCO INC.
 - b. Description: Bronze body and bonnet and bronze stem.
 - c. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - d. Pressure Rating: 175 psig minimum.
 - e. End Connections: Threaded.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve 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. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. Flowserve.
 - c. Mueller Co.; Water Products Division.
 - d. U.S. Pipe.
 - 2. Description: Sleeve and valve compatible with drilling machine.
 - 3. Standard: MSS SP-60.
 - 4. Tapping Sleeve: Cast-iron, ductile-iron, or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Sleeve shall match size and type of pipe material being tapped and have recessed flange for branch valve.
 - 5. 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 in diameter.
 - 1. Operating Wrenches: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts:
 - 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 Cast Iron Pipe Company; American Flow Control Division.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. NIBCO INC.
 - e. Tyco Fire & Building Products LP.
- 2. Description: Vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.
 - 3. Standards: UL 789 and "Approval Guide," published by FM Global, listing.

2.8 FIRE-DEPARTMENT CONNECTIONS

- 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. Guardian Fire Equipment, Inc.
 - 2. Potter Roemer.
 - 3. Reliable Automatic Sprinkler Co., Inc.
- B. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire-department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- high brass sleeve; and round escutcheon plate.
- C. Standard: UL 405.
- D. Connections: Two NPS 2-1/2 inlets and one NPS 4 outlet.
- E. Inlet Alignment: Inline, horizontal.
- F. Finish Including Sleeve: Polished chrome plated.
- G. Escutcheon Plate Marking: "AUTO SPKR."

2.9 ALARM DEVICES

- A. General: UL 753 and "Approval Guide," published by FM Global, 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 Division Section "Earthwork."

3.2 PIPING INSTALLATION

- A. 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.
- 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. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration.
- E. 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 at building 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.
- F. 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.
- G. Comply with requirements in Division 13 Sections for fire-suppression-water piping inside the building.

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. Remove scale, slag, dirt, and debris from outside and inside of pipes and fittings before assembly.

- E. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
- F. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.
- G. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.
- H. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.4 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints.
- 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.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 VALVE INSTALLATION

- A. UL-Listed or FM-Approved Gate Valves: Comply with NFPA 24. Install each underground valve with stem pointing up and with vertical cast-iron indicator post.
- B. MSS Valves: Install as component of connected piping system.

3.6 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 two sides of each fire-department connection. Pipe bollards are specified in Division 5 Section "Metal Fabrications."

3.7 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. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.

- D. 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.
- E. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Division 13 Sections.

3.8 CONNECTIONS

- A. Connect fire-suppression water-service piping to existing water main. Use tapping sleeve and tapping valve.
- B. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.9 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 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 0 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.

3.10 IDENTIFICATION

- A. Install continuous underground 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 Division Section "Earthwork."

3.11 CLEANING

- A. Clean fire-suppression water-service piping as follows:
 - 1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging 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.
- B. Prepare reports of purging activities.

3.12 PIPING SCHEDULE

- A. Underground and underslab fire-suppression water-service piping NPS 3 to NPS 6 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.

3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
- B. Underground fire-suppression water-service shutoff valves NPS 3 and larger shall be the following:
 - 1. 175-psig, UL-listed or FM-approved, iron, nonrising-stem gate valves.
- C. Indicator-post underground fire-suppression water-service valves NPS 3 and larger shall be 175-psig, UL-listed or FM-approved, iron, nonrising-stem gate valves with indicator-post flange.

END OF SECTION

SECTION 21 13 13

WET PIPE FIRE SUPPRESSION SPRINKLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Sprinklers.
 - 4. Alarm devices.
 - 5. Pressure gages.

1.2 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.3 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated on plans.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - b. Office Space: Light Hazard.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - 4. Maximum Protection Area per Sprinkler: Per UL listing.
 - 5. Maximum Protection Area per Sprinkler:
 - a. Office Space Areas: 120 sq. ft.
 - b. Mechanical Equipment Rooms: 130 sq. ft..

- c. Electrical Equipment Rooms: 130 sq. ft..
 - d. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
- a. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer or NICCT level III fire protection designer responsible for their preparation.
- D. Qualification Data: Tennessee Registered Fire Protection Contractor.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- F. Field Test Reports and Certificates: 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."
- G. 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 or NICCT level III fire protection designer.
- 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. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black Steel Pipe: ASTM A 53/A 53M, Type E Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Black Steel Couplings: ASTM A 865, threaded.
- D. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.
 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 1. Valves shall be UL listed or FM approved.
 2. Minimum Pressure Rating: 175 psig.
- B. 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. American Cast Iron Pipe Company; Waterous Company Subsidiary.

- b. Anvil International, Inc.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. Fire Protection Products, Inc.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Potter Roemer.
 - j. Reliable Automatic Sprinkler Co., Inc.
 - k. Tyco Fire & Building Products LP.
 - l. Victaulic Company.
 - m. Viking Corporation.
 - n. Watts Water Technologies, Inc.
 - 2. Standard: UL 312.
 - 3. Pressure Rating: 250 psig minimum.
 - 4. Type: Swing check.
 - 5. Body Material: Cast iron.
 - 6. End Connections: Flanged or grooved.
- C. Iron OS&Y Gate 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. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Tyco Fire & Building Products LP.
 - h. United Brass Works, Inc.
 - i. Watts Water Technologies, Inc.
 - 2. Standard: UL 262.
 - 3. Pressure Rating: 250 psig minimum.
 - 4. Body Material: Cast or ductile iron.
 - 5. End Connections: Flanged or grooved.

2.5 TRIM AND DRAIN VALVES

- A. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Minimum Pressure Rating: 175 psig.
- B. Ball 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. Fire Protection Products, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Potter Roemer.
 - e. Red-White Valve Corporation.
 - f. Tyco Fire & Building Products LP.
 - g. Victaulic Company.
 - h. Watts Water Technologies, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. 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. AFAC Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - f. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. 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. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.

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.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

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, Inc.
 - b. National Fittings, Inc.
 - c. Tyco Fire & Building Products LP.
 - d. 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-T 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. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
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.

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. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
 - 2. Standard: UL 199.
 - 3. Pressure Rating: 175 psig minimum.
 - 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. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 3. Pressure Rating: 175 psig minimum.
 - 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. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
 - 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. Fivalco Inc.
 - b. FlexHead Industries, Inc.
 - c. Gateway Tubing, Inc.
- 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.
 - 2. Tyco Fire & Building Products LP.
 - 3. Victaulic Company.
 - 4. Viking Corporation.
- B. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Nonresidential Applications: UL 199.
 - 2. 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.
- D. Sprinkler Finishes:
 - 1. Chrome plated.
 - 2. Bronze.
 - 3. Painted.
- E. Special Coatings:
 - 1. Wax.
 - 2. Lead.
 - 3. Corrosion-resistant paint.
- F. 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: Plastic, white finish, one piece, flat.
 - 2. Sidewall Mounting: Plastic, white finish, one piece, flat.
- G. 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.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.9 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Valve Supervisory Switches:
 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. Fire-Lite Alarms; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design: Signals that controlled valve is in other than fully open position.
- C. Water-Flow Indicators:
 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. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
 2. Standard: UL 346.
 3. Water-Flow Detector: Electrically supervised.
 4. Components: Two single-pole, double-throw circuit switches for 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 if removed.
 5. Type: Paddle operated.
 6. Pressure Rating: 250 psig.

7. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

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. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.10 PRESSURE GAGES

- 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. AMETEK; U.S. Gauge Division.
 2. Ashcroft, Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 250 psig minimum.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

2.11 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with set-screws.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw or spring clips.
- E. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated finish with concealed hinge and set-screw.
- F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed hinge, set-screw or spring clips.

- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.12 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.

2.13 SLEEVE SEALS

- 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. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 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: Plastic.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.14 GROUT

- A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink, and 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 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- 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.
- L. Install pressure gages on riser or feed main and at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- M. Fill wet sprinkler system piping with water.

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, 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.
- J. 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.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 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. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
 - 3. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air supply piping.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. 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.

3.6 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.7 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 - 5. Bare Piping in Equipment Rooms: One piece, cast brass.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.8 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls. Contractor shall seal all penetrations in supply air plenum air tight.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 7 Section "Joint Sealants."
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 7 Section "Joint Sealants."

- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel-sheet sleeves.
 - 2. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
 - 3. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - 4. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. PVC-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 7 Section "Through-Penetration Firestop Systems."

3.9 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.10 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Paint all exposed sprinkler piping RED.
- C. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.13 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Black steel, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Sprinkler system, NPS 2 and smaller, shall be one of the following:
 - 1. Standard-weight black steel pipe with threaded ends; Black steel, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight black steel pipe with plain ends; Black steel, plain-end-pipe fittings; and twist-locked joints.
 - 3. Standard-weight black steel pipe with cut-grooved ends; black steel, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- D. Standard-pressure, wet -pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:
 - 1. Standard-weight black steel pipe with threaded ends; black steel, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight black steel pipe with cut-grooved ends; black steel, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.14 SPRINKLER SCHEDULE

- A. Use wet sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Lay-In Suspended Ceilings: Semi-recessed sprinklers.
 - 3. Rooms with Hard or Special Finish Ceilings: Concealed sprinklers
 - 4. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 - 2. 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.
 - 3. Concealed Sprinklers: Coordinate finish color with Architect and match ceiling finish.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Equipment installation requirements common to equipment sections.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 QUALITY ASSURANCE

- A. The plumbing contractor is aware that the space beneath the access floor will be used as an air delivery plenum and as such will take the necessary precautions when installing their work so as not to impact the integrity of the plenum space specific to air leakage and cleanliness. Any penetrations or holes in the underfloor plenum created for or resulting from the work performed by the division 22 plumbing contractors are required to be properly sealed to prevent air leakage.
- B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Solvent Cements for Joining Plastic Piping:
 - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 2. Refer to Section 01 6116 for VOC content limitations.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space

between pipe and sleeve.

- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Plastic. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC Pipe: ASTM D 1785, Schedule 40.
- F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 FIXTURES

- A. Fixtures shall be as specified or shall be similar in design, quality and performance from one of the following manufacturers:
 - 1. American Standard
 - 2. Caroma
 - 3. Elkay
 - 4. Kohler
 - 5. Toto

2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. The General Contractor must coordinate all systems and comply with the RAF shop drawings.
- B. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- C. 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 Coordination Drawings.
- 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. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Install escutcheons for penetrations of walls, ceilings, and floors.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- T. Paint all exposed piping as specified on plans.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. 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 unless dry seal threading is specified.
 - 2. 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.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Plastic 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. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket

fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

3. PVC Nonpressure Piping: Join according to ASTM D 2855.

I. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

A. 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. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze swing check valves.
3. Bronze gate valves.
4. Bronze globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

- A. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
1. Handwheel: For valves other than quarter-turn types.
 2. Handlever: For quarter-turn valves NPS 6 and smaller.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Solder Joint: With sockets according to ASME B16.18.
2. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

A. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

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
 - b. Milwaukee Valve Company
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Regular.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

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
 - b. Milwaukee Valve Company
 - c. NIBCO INC.
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.
- f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

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
 - b. Milwaukee Valve Company
 - c. NIBCO INC.
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.
 - f. Disc: PTFE or TFE.

2.4 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate 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
 - b. Milwaukee Valve Company
 - c. NIBCO INC
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.5 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

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
- b. Milwaukee Valve Company
- c. NIBCO INC

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

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
- b. Milwaukee Valve Company
- c. NIBCO INC

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

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 and 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 valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or gate valves.
 - 2. Throttling Service: Globe or ball valves.
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, 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.

3.4 DOMESTIC, HOT-, HOT RECIRCULATION-, AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 125, bronze nonmetallic disc.
 - 3. Ball Valves: Two piece, regular port, bronze with bronze trim.
 - 4. Bronze Swing Check Valves: Class 125, bronze or nonmetallic disc.
 - 5. Bronze Gate Valves: Class 125, NRS.
 - 6. Bronze Globe Valves: Class 125, bronze or nonmetallic disc.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING

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. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
- D. See Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
- E. See Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- 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 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.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 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: Pre-galvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 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 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 copper-coated steel

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-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.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
- C. Properties: Nonstaining, noncorrosive, and nongaseous.
- D. Design Mix: 5000-psi, 28-day compressive strength

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use

- operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 15 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. 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.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. 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.
- L. 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.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and 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; and 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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

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 PAINTING

- A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-69 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 finish.
- 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 copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. 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. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- J. 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.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. 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 (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).

- c. Heavy (MSS Type 33): 3000 lb (1360 kg).
- 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.

- 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

a. Domestic Water Piping:

- 1) Background Color: Blue.
- 2) Letter Color: White.

b. Sanitary Piping

- 1) Background Color: Green
- 2) Letter Color: White

c. Vent Piping:

- 1) Background Color: Red
- 2) Letter Color: White

d. Storm Piping

- 1) Background Color: Grey.
- 2) Letter Color: White.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Fiberglass.
 - 2. Adhesives.
 - 3. Mastics.
 - 4. Sealants.
 - 5. Factory-applied jackets.
 - 6. Field-applied jackets.
 - 7. Tapes.
- B. Related Sections include the following:
 - 1. Division 01 Section 01 6116 "Volatile Organic Compound (VOC) Content Restriction"
 - 2. Division 23 Section "HVAC Insulation."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Volatile Organic Compound Content Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- C. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- D. Fiberglass Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 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. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armacell LCC; BLV Adhesive.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - c. RBX Corporation; Rubatex Contact Adhesive.
- C. Fiberglass Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.

2.3 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: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.4 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.

- c. RPR Products, Inc.; Insul-Mate.
- 2. Factory cut and rolled to size.
- 3. Finish and thickness are indicated in field-applied jacket schedules.
- 4. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
- 5. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- C. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
- D. TAPES
- E. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - c. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 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. 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 equipment and piping including fittings, valves, and specialties.

- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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, soften, or otherwise attack insulation or jacket in either wet or dry state.
- 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. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- 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 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.
 - 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.
 - 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 as recommended by insulation material manufacturer 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 more than 75 percent of its nominal thickness.
- 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 similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Testing agency labels and stamps.
 - 2. Nameplates and data plates.
 - 3. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. 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 Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

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.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as 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 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 used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 two 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 and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. 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 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- 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 Straight Pipe, Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 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.

3.6 FIBER GLASS INSULATION INSTALLATION

- 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 factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but 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 preformed 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 mineral-fiber 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 preformed sections of same material as 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 preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered 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 FIELD-APPLIED JACKET INSTALLATION

- A. 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 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. INDOOR PIPING INSULATION SCHEDULE
 1. Domestic Cold and Hot Water, Recirc: Insulation shall be:
 - a. Fiberglass, Preformed Pipe Insulation, Type I: 1/2 inch thick with factory installed ASJ jacket.
 2. Condensate drains:
 - a. Flexible Elastomeric, 1/2" thick with painted covering
 3. Condenser water and horizontal rain water leaders:
 - a. Fiberglass, Preformed Pipe Insulation, Type I: 1/2 inch thick with factory installed ASJ jacket.

END OF SECTION

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Flexible connectors.
 - 3. Escutcheons.
 - 4. Sleeves and sleeve seals.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 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.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with NSF 14 for plastic, potable water-service and domestic water piping and components. Include marking "NSF-pw" on piping.
- D. Comply with NSF 61 for materials for potable water-service and domestic water piping and components.

1.4 COORDINATION

- A. Coordinate connection to water main with utility company.

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.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated. Refer to Section 01 6116 for VOC content limitations.

2.4 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.

- C. Dielectric Couplings:
 - 1. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.
- D. Dielectric Nipples:
 - 1. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.6 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.7 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

2.8 SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 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: Plastic.
- 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.9 GROUT

- A. Standard: ASTM C 1107, 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 EARTHWORK

- A. Comply with Civil Engineering plans and specifications.

3.2 PIPING INSTALLATION

- 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 shutoff valve and valve box outside the building at the domestic water service entrance. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install domestic water piping level and plumb.
- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- F. 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.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping adjacent to equipment and specialties to allow service and maintenance.
- I. Install piping to permit valve servicing.

- J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.3 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: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 15 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Water –service piping and Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.6 DIELECTRIC FITTING INSTALLATION

- 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, nipples or unions.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42 clamps.
 - 2. 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.
 - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Install supports for vertical steel piping every 15 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow 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. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 15 plumbing fixture Sections for connection sizes.
 - 3. 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 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece cast brass with polished chrome-plated finish or stamped steel with set screw or spring clips.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece cast brass with polished chrome-plated finish or stamped steel with set screw or spring clips.
 - 4. Bare Piping in Unfinished Service Spaces: One piece stamped steel with set screw or spring clips.
 - 5. Bare Piping in Equipment Rooms: One piece stamped steel with set screw or spring clips.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.10 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to

- extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 4. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestop materials and installations.

3.11 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Tests:
 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. .
 3. 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.
 4. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3.13 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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

3.14 PIPING SCHEDULE

- 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, NPS 2 and smaller, shall be the following:
 1. Soft copper tube, ASTM B 88, Type K; without joints.
- D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and soldered joints.

3.15 VALVE SCHEDULE

- A. See Section 220523 for valve schedule.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Wall hydrants.
 - 2. Drain valves.
 - 3. Water hammer arresters.
 - 4. Trap-seal primer valves.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 WALL HYDRANTS

- A. Nonfreeze Wall 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. Josam Company.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Woodford Manufacturing Company.
 - 2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
 - 3. Pressure Rating: 125 psig.
 - 4. Operation: Loose key.
 - 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.

6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

2.2 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.

2.3 WATER HAMMER ARRESTERS

- A. Water Hammer Arresters:
 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:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. PPP Inc.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Watts Drainage Products Inc.
 3. Standard: ASSE 1010 or PDI-WH 201.
 4. Type: Copper tube with piston.
 5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.4 TRAP-SEAL PRIMER VALVES

- A. Supply-Type, Trap-Seal Primer 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:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 3. Standard: ASSE 1018.
 4. Pressure Rating: 125 psig minimum.

5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install water hammer arresters in water piping according to PDI-WH 201.
- C. Install supply-type, trap-seal primer valves 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.
- D. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.2 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 11 23
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. In-line, seal-less centrifugal pumps.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.3 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- 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. Armstrong Pumps Inc.
 - 2. Bell & Gossett Domestic Pump; ITT Corporation.
 - 3. Grundfos Pumps Corp.
 - 4. TACO Incorporated.
- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- C. Pump Construction:
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 - 2. Casing: Bronze, with threaded or companion-flange connections.
 - 3. Impeller: Plastic.
 - 4. Motor: Single speed, unless otherwise indicated.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Common Motor Requirements for Plumbing 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 Division 26 Sections.

2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 - 1. Type: Water-immersion temperature sensor, for installation in piping.
 - 2. Range: 50 to 125 deg F.
 - 3. Enclosure: NEMA 250, NEMA Type 4.
 - 4. Operation of Pump: On or off.
- B. Timers: Electric, for control of hot-water circulation pump.
 - 1. Type: Programmable, seven-day clock with manual override on-off switch.
 - 2. Enclosure: NEMA 250, Type 1 suitable for wall mounting.
 - 3. Operation of Pump: On or off.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Install continuous-thread hanger rods and spring hangers of size required to support pump weight.
- D. Install thermostats in hot-water return piping.
- E. Install timers on wall in water heater room.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with Division 26 Sections for electrical connections, and wiring methods.
- E. Connect thermostats and timers to pumps that they control.

3.3 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.2 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.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- B. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.
- C. PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

2. Solvent Cement and Adhesive Primer:

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Aboveground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 2. PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Do not install PVC piping in the return air plenum.
- B. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
 1. PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Section "Sanitary Sewerage."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- E. 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."
- F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 1. Building Sanitary Drain: 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. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- J. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- K. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- C. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
- D. Install supports for vertical cast-iron soil piping every 15 feet.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

- 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
- H. Install supports for vertical piping every 48 inches.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:
 - 1. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Specialties."
 - 2. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- C. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
 - 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

3.6 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Miscellaneous sanitary drainage piping specialties.
 - 4. Flashing materials.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

B. QUALITY ASSURANCE

- C. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Cast-Iron Cleanouts:
 - 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. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure: Countersunk, plastic plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Floor Cleanouts:
 - 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. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- d. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Outlet Connection: Hub outlet with gasket.
7. Closure: Plastic plug.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM D 2665, solid-wall drainage pipe fitting and riser to cleanout.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
 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. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.6.3.
 3. Pattern: drain.
 4. Body Material: Gray iron.
 5. Clamping Device: Required.
 6. Outlet: Bottom.
 7. Top or Strainer Material: Nickel bronze.
 8. Top of Body and Strainer Finish: Nickel bronze.
 9. Top Shape: Square.
 10. Dimensions of Top or Strainer: 6x6
 11. Top Loading Classification: Medium Duty.
 12. Inlet Fitting: Gray iron, with threaded inlet and hub outlet with gasket, and trap-seal primer valve connection.

2.3 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- 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. 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. 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.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Assemble open drain fittings and install with top of hub 2 inches above floor.
- G. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- H. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

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

SECTION 22 14 23

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof drains.
 - 2. Cleanouts.
 - 3. Flashing materials.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

- A. Cast-Iron, General-Purpose Roof Drains:
 - 1. Standard: ASME A112.6.4, for general-purpose roof drains.
 - 2. Body Material: Cast iron.
 - 3. Outlet: Bottom.
 - 4. Extension Collars: Required.
 - 5. Underdeck Clamp: Required.
 - 6. Sump Receiver Plate: Required.
 - 7. Dome Material: Aluminum.
- A. Metal, Cornice and Gutter Roof Drains:
 - 1. Standard: ASME A112.6.4, for cornice and gutter roof drains.
 - 2. Body Material: Metal.
 - 3. Dimension of Body: Nominal 6-inch diameter.
 - 4. Outlet: Bottom.
 - 5. Dome Material: Bronze.
 - 6. Membrane flashing clamp.

2.2 CLEANOUTS

A. Floor Cleanouts:

1. Standard: ASME A112.36.2M, for cleanouts.
2. Size: Same as connected branch.
3. Type: Threaded, adjustable housing.
4. Body or Ferrule Material: Cast iron.
5. Outlet Connection: Inside calk.
6. Closure: Plastic plug with tapered threads.
7. Adjustable Housing Material: Cast iron with threads.
8. Frame and Cover Material and Finish: Nickel-bronze, copper alloy
9. Frame and Cover Shape: Round.
10. Top-Loading Classification: Medium Duty.
11. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Test Tees:

1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk or raised head, brass.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
2. Size: Same as connected drainage piping.
3. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure: Countersunk, threaded plastic plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Square wall-installation frame and cover.

2.3 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07 Sections.
 - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Install expansion joints, if indicated, in roof drain outlets.
 - 3. Position roof drains for easy access and maintenance.
- B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
 - 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 - 3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate cleanouts 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. Install test tees in vertical conductors and near floor.
- F. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.

2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
 - D. Secure flashing into sleeve and specialty clamping ring or device.
 - E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

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

SECTION 22 14 29

SUMP PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submersible sump pumps.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and maintenance data.

1.3 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
 - 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. Goulds Pumps.
 - b. Liberty Pumps.
 - c. Myers.
 - d. Zoeller Company.
 - 2. Description: Factory-assembled and -tested sump-pump unit.
 - 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
 - 4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.

5. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron design for clear wastewater handling, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
9. Controls:
 - a. Enclosure: NEMA 250, Type 4x wall-mounted.
 - b. Switch Type: Mechanical-float, Mercury-float, or Pressure type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Self-cleaning oil sensor probe detection system.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
 - e. Audible alarms with silence switch and LED indicator lights for the following events:
 - 1) High liquid level in sump.
10. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing 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 Division 26 Sections.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation and filling are specified in Division 31 Section "Earth Moving."

3.2 INSTALLATION

- A. Pump Installation Standard: Comply with HI 1.4 for installation of sump pumps.

END OF SECTION

SECTION 22 33 00
ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Light-commercial electric water heaters.
 - 2. Water heater accessories.

1.2 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.
- D. Warranty.

1.3 QUALITY ASSURANCE

- A. 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.
- B. ASHRAE/IESNA-90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
- 2. Warranty Period(s): From date of Substantial Completion:
 - a. Commercial Electric Water Heaters: Five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 LIGHT-COMMERCIAL ELECTRIC WATER HEATERS

- A. Description: Comply with UL 174 for household, storage electric water heaters.
 - 1. Available Manufacturers:
 - a. Bradford White Corporation.
 - b. Lochinvar Corporation.
 - c. Smith, A. O. Water Products Company.
 - d. State Industries, Inc.
 - 2. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - 3. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1-2004.
 - e. Jacket: Steel with enameled finish.
 - f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation, unless otherwise indicated.
 - h. Temperature Control: Adjustable thermostat for each element.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at

least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

2.3 WATER HEATER ACCESSORIES

- A. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.
- C. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on housekeeping pad.
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, 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.
- D. 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 water heaters that do not have tank drains. Refer to Division 15 Section "Plumbing Specialties" for hose-end drain valves.
- E. Fill water heaters with water.

3.2 CONNECTIONS

- A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- B. Ground equipment according to Division 16 Section "Grounding and Bonding."
- C. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial electric water heaters. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Faucets for lavatories.
2. Toilet seats.
3. Fixture supports.
4. Water closets.
5. Lavatories.

1.2 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.
- B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- E. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
1. Vitreous-China Fixtures: ASME A112.19.2M.
 2. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- F. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Faucets: ASME A112.18.1.
 2. NSF Potable-Water Materials: NSF 61.
 3. Pipe Threads: ASME B1.20.1.
 4. Supply Fittings: ASME A112.18.1.
 5. Brass Waste Fittings: ASME A112.18.2.
- G. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Brass and Copper Supplies: ASME A112.18.1.
 2. Brass Waste Fittings: ASME A112.18.2.
 3. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- H. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Flexible Water Connectors: ASME A112.18.6.
 2. Grab Bars: ASTM F 446.
 3. Pipe Threads: ASME B1.20.1.
 4. Plastic Toilet Seats: ANSI Z124.5.
 5. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

- A. Basis-of-Design Product: See plumbing fixture schedule for plumbing fixtures and trim.

2.2 LAVATORY FAUCETS

- A. Lavatory Faucets:
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 Standard Companies, Inc.
 - b. Chicago Faucets.
 - c. Kohler Co.
 - d. T & S Brass and Bronze Works, Inc.
 - e. TOTO USA

2.3 SINK FAUCETS

- A. Sink Faucets:
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 Standard Companies
- b. Chicago Faucets.
- c. Kohler Co.
- d. T & S Brass and Bronze Works, Inc.

2.4 FLUSHOMETERS

A. Flushometers:

- 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. Sloan Valve Company.
 - b. TOTO USA, Inc.
 - c. Zurn Plumbing Products Group; Commercial Brass Operation.

2.5 TOILET SEATS

A. Toilet Seats:

- 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. Bemis Manufacturing Company.
 - b. Church Seats.
 - c. Olsonite Corp.

2.6 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

- 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. McGuire Manufacturing Co., Inc.
 - b. Plumberex Specialty Products Inc.
 - c. TRUEBRO, Inc.

2.7 FIXTURE SUPPORTS

- A. 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.

2. Smith, Jay R. Mfg. Co.
3. Zurn Plumbing Products Group; Specification Drainage Operation.

2.8 WATER CLOSETS

A. Water Closets:

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 Standard Companies, Inc.
 - b. Kohler Co.
 - c. Mansfield Plumbing Products, Inc.
 - d. TOTO USA, Inc.

2.9 URINALS

A. Urinals:

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 Standard Companies, Inc.
 - b. Kohler Co.
 - c. Mansfield Plumbing Products, Inc.
 - d. TOTO USA, Inc.

2.10 LAVATORIES

A. Lavatories:

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 Standard Companies, Inc.
 - b. Kohler Co.
 - c. Mansfield Plumbing Products, Inc.
 - d. TOTO USA, Inc.

2.11 SERVICE SINKS

A. Service Sinks:

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. Acorn Engineering Company.
- b. Fiat Products.
- c. Florestone Inc.
- d. Stern-Williams Co., Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install carrier supports for wall-mounting fixtures.
- C. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- D. Install wall-mounting fixtures with tubular waste piping attached to supports.
- E. Install fixtures level and plumb according to roughing-in drawings.
- F. 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.
- G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- H. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- I. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- J. Install toilet seats on water closets.
- K. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- L. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- M. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 16 Section "Grounding and Bonding."
- D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Sleeves.
 5. Escutcheons.
 6. Grout.
 7. Equipment installation requirements common to equipment sections.
 8. Concrete bases.
 9. Supports and anchorages.

1.02 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.03 QUALITY ASSURANCE

- A. The HVAC contractor is aware that the space beneath the access floor will be used as an air delivery plenum and as such will take the necessary precautions when installing their work so as not to impact the integrity of the plenum space specific to air leakage and cleanliness. Any penetrations or holes in the underfloor plenum created for or resulting from the work performed by the division 23 HVAC contractors are required to be properly sealed to prevent air leakage.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- C. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- D. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.02 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493. Refer to VOC limits in Section 01 61 16.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656. Refer to VOC limits in Section 01 61 16.

2.03 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.04 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Plastic. Include two for each sealing element.

- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.06 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.

2.07 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. The General Contractor must coordinate all systems and comply with the RAF shop drawings.
- B. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- C. 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 Coordination Drawings.

- 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. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Install escutcheons for penetrations of walls, ceilings, and floors.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- F. 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 unless dry seal threading is specified.
 - 2. 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.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.03 PIPING CONNECTIONS

- A. 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. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Paint all HVAC piping as specified in plans.

3.05 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. 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 the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3.

3.06 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.07 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.02 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.02 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.

- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.05 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation.

Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 23 05 19

METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product certificates.
- C. Operation and maintenance data.

PART 2 - PRODUCTS

2.01 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 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. Tterice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
 - 4. Case Form: Adjustable angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 7. Window: Glass.
 - 8. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 - 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.02 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.03 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

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. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Terice, H. O. Co.
 - d. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal.
11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.04 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- H. Install thermometers in the following locations:
 - 1. Common supply and return tower condenser water and critical systems loop water piping.
- I. Install pressure gages in the following locations:
 - 1. Inlet and outlet of each chiller chilled-water and condenser-water connection.
 - 2. Suction and discharge of each pump.

3.02 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Condenser Water Piping: 0 to 150 deg F.

3.05 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Condenser Water Piping: 0 to 100 psi.

END OF SECTION

SECTION 23 05 23

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. High-performance butterfly valves.
3. Bronze swing check valves.
4. Iron swing check valves.
5. Bronze gate valves.
6. Iron gate valves.
7. Chainwheels.

B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.02 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.

1.03 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of valves.
- C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handlever: For quarter-turn valves NPS 6 and smaller.
 - 3. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.

2.02 BRONZE BALL VALVES

- A. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:
 - 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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.

- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

2.03 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly 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. DeZurik Water Controls.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Tyco Valves & Controls; a unit of Tyco Flow Control.
2. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 285 psig at 100 deg F.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
 - e. Seat: Reinforced PTFE or metal.
 - f. Stem: Stainless steel; offset from seat plane.
 - g. Disc: Carbon steel.
 - h. Service: Bidirectional.

2.04 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

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. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
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.

- f. Disc: Bronze.

B. Class 125, Iron Swing Check Valves with Metal 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. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

C. Class 125, NRS Bronze Gate 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. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

D. Class 125, NRS, Iron Gate 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. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Powell Valves.

2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

E. Class 125, OS&Y, Iron Gate 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. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

2.05 CHAINWHEELS

- 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. Babbitt Steam Specialty Co.
 2. Roto Hammer Industries.
 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to butterfly valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 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 chainwheels on operators for butterfly gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

3.03 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.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly or gate valves.
 - 2. Throttling Service: Ball or butterfly valves.
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring.

- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, 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 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.05 TOWER CONDENSER WATER AND CRITICAL SYSTEMS LOOP WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Ball Valves: Two piece, regular port,
 - 3. Bronze Swing Check Valves: Class 125 bronze disc.
 - 4. Bronze Gate Valves: Class 125, NRS.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. High-Performance Butterfly Valves: Class 150, single flange.
 - 3. Iron Swing Check Valves: Class 125, metal seats.
 - 4. Iron Gate Valves: Class 125, NRS or OS&Y.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Pipe positioning systems.
 - 5. Fastener systems.
 - 6. Equipment supports.

1.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC 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 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.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.

- 2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 QUALITY ASSURANCE

- A. Structural Steel 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.

PART 2 - PRODUCTS

2.01 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 or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 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. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe 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 copper-coated steel.

2.02 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-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.

2.04 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.05 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.06 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.07 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

- B. Grout: ASTM C 1107, 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

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. 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.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. 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.

- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. 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.
- L. 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.
 - 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 same thickness as piping insulation.

3.02 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.

3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and 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; and 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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 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.

3.05 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 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 finish.

- 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 metal trapeze pipe hangers 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. 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.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 6. 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.
 - 7. 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.
 - 8. 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 might occur.
 - 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. 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.
- 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 up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): 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. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. 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.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 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. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Elastomeric hangers.
3. Spring hangers.

1.02 SUBMITTALS

A. Product Data: For each product indicated.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

A. 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:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control.
3. Mason Industries.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene, rubber, or hermetically sealed compressed fiberglass.

C. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

D. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside 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. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES, OSHPD, or an agency acceptable to authorities having jurisdiction.

3.02 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- C. Drilled-in Anchors:
 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.03 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.

3.04 HVAC VIBRATION-CONTROL DEVICE SCHEDULE

A. Provide vibration control for the following supported or suspended equipment

1. Indoor air handling units: Elastomeric or Spring hangers.
2. Condensing unit: Isolation pads.
3. In-line fans: Spring hangers.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.

1.02 SUBMITTAL

- A. Product Data: For each type of product indicated.

1.03 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch or Aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

2.02 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially covered circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings.
 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

2.03 DUCT LABELS

- A. Self-Adhesive Duct Labels: Printed plastic with contact-type, permanent-adhesive backing.
- B. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 - 1. Tower Condenser Water and Critical Systems Loop Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 2. Refrigerant Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.04 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Cold-air supply ducts:
 - a. Background Color: Blue.
 - b. Letter Color: White.
 - 2. Exhaust-, outside-, relief-, and return-air ducts:
 - a. Background Color: Green.
 - b. Letter Color: White.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are concealed by removable ceiling system.
- C. Do not label fabric ducts or exposed ducts in finished areas.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-volume air systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Variable-flow hydronic systems.
 - 3. Air Sampling

1.02 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 entity engaged to perform TAB Work.

1.03 SUBMITTALS

- A. Certified TAB reports.

1.04 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by AABC or NEBB.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 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 systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices 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 equipment performance data including fan and pump curves.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units, such as underfloor boxes, and verify that they are accessible and their controls are connected and functioning.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine system pumps to ensure absence of entrained air in the suction piping.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. 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.

3.02 PREPARATION

- A. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.

4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to 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.
 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets 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. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 15 Section "HVAC 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.

3.04 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' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. 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.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.

- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 15 Section "Metal Ducts."

3.05 PROCEDURE FOR BALANCING CONDENSER WATER SYSTEM

- A. Verify that all balancing, control, and isolation valves are wide open. Self-contained units to be indexed to economizer mode.
- B. Operate two pumps with their triple duty valves fully open and determine the total system flow rate by measuring the pump differential pressure and comparing to a certified pump curve. Take pressure readings at the same test locations used by the pump manufacturer.
- C. Adjust the individual pump triple duty valves to approximately 110% of design flow. Design flow is 720 GPM per pump, 1440 GPM total. Each pump should be set at 800 GPM.
- D. Measure the flow at each calibrated balancing valve and record the GPM.
- E. Calculate the ratio of measured flow to design flow. This is the flow quotient, $FQ = \text{actual flow} / \text{design flow}$.
- F. The balancing valve with the lowest FQ is the critical branch and is not adjusted in this procedure.
- G. Adjust the balancing valve (BV) for the next (second) lowest FQ until both BVs (second and critical branch) are at the same FQ. Note: when the second valve is adjusted the FQ in the critical branch BV also changes. Continued adjustment is required to make their FQs equal. Once they are equal, they will remain equal or in proportional balance while other BVs are adjusted. Remember that the critical branch BV is not adjusted.
- H. Adjust the balancing valve (BV) for the next (third) lowest FQ until all three BVs valves (third, second, and critical branch) are at the same FQ. Note: when the third valve is adjusted the FQ in the second and critical branch BVs also change, however the second and critical branch BVs will be equal and will not need to be adjusted. Continued adjustment of the third BV is required until all three FQs (third, second, and critical branch) are equal. Once they are equal, they will remain equal or in proportional balance while other BVs are adjusted.
- I. Continue the procedure until all BVs have been adjusted to be in balance at approximately the same FQ.
- J. Adjust the individual pump triple duty valves to design flow.
- K. Measure and record the system pressure control setpoint.
- L. Fully open the individual pump triple duty valves except as required to balance the equipment room flow to remain equal at each pump. Allow the BAS to control the pump speed to maintain the system pressure control setpoint.
- M. Re-measure all BVs and adjust the system pressure control setpoint to set all BV flows to within +/- 10% of design flow. Record final values.

3.06 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

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1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Water Flow Rate (Loop): Plus or minus 10 percent.

3.07 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems. Report shall follow guidelines of AABC and/or NEBB.
 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.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. 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 contractor.
 3. Project name.
 4. Project location.
 5. Contractor's name and address.
 6. Report date.
 7. Signature of TAB supervisor who certifies the report.
 8. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 9. 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.
 10. Nomenclature sheets for each item of equipment.
 11. Data for terminal units, including manufacturer's name, type, size, and fittings.
 12. Notes to explain why certain final data in the body of reports vary from indicated values.
 13. Test conditions for fans and pump 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. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. Settings for supply-air, static-pressure controller.
 - f. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 1. Quantities of outdoor, supply, return, and exhaust airflows.

2. Water flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

3.08 ADDITIONAL TESTS

- A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Insulation Materials:

- a. Flexible elastomeric.
- b. Mineral fiber.
- c. Polystyrene.

2. Adhesives.
3. Mastics.
4. Sealants.
5. Factory-applied jackets.
6. Field-applied jackets.
7. Tapes.
8. Securements.
9. Corner Angles

B. Related Sections:

1. Division 22 Section "Plumbing Insulation."
2. Division 23 Section "Metal Ducts" for duct liners.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Provide cut sheets for any adhesives and sealants that illustrates VOC content.

C. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Detail removable insulation at piping specialties, equipment connections, and access panels.
5. Detail application of field-applied jackets.

1.03 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing

and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Owens Corning; All-Service Duct Wrap.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. CertainTeed Corp.; Commercial Board.
- b. Johns Manville; 800 Series Spin-Glas.
- c. Knauf Insulation; Insulation Board.
- d. Owens Corning; Fiberglas 700 Series.

H. Mineral-Fiber, Preformed Pipe Insulation:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Owens Corning; Fiberglas Pipe Insulation.
- 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Styrofoam.
 - b. Knauf Insulation; Knauf Polystyrene.

J. Rigid Phenolic Pipe Insulation:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insul-Phen
 - b. Approved equal.
- 2. Closed Cell Phenolic Insulation, CFC and HCFC Free. Nominal Density ASTM D-1622, 3.755 LB per foot density. Thermal conductivity ASTM C-518, 0.16 Btu-in/hr. ft F at 75 degrees F. Water Vapor Permeability ASTM-96, 0.02 Perm-inch. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 1- or 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Morgan Thermal Ceramics; FireMaster FastWrap XL.
 - b. 3M; Fire Barrier Duct Wrap 615+.

- c. Unifrax Corporation; FyreWrap Elite 1.5.

2.03 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. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armacell LCC; BLV Adhesive.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - c. RBX Corporation; 720-LVOC Adhesive.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. Mon-Eco Industries, Inc.; 22-65.
 - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. Mon-Eco Industries, Inc.; 22-65.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated

according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. Mon-Eco Industries, Inc.; 55-40.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. Mon-Eco Industries, Inc.; 55-50.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.05 SEALANTS

- A. Joint Sealants:
 - 1. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mon-Eco Industries, Inc.; 44-52 Low VOC.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mon-Eco Industries, Inc.; 44-52 Low VOC.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.06 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 C 1136, Type I.
 2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.07 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.

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.
 5. Factory-fabricated tank heads and tank side panels.
- C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Sheet and roll stock ready for shop or field sizing.
 3. Finish and thickness are indicated in field-applied jacket schedules.
 4. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white stucco-embossed aluminum-foil facing.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Polyguard; Alumaguard 60.
 - b. VentureClad; 1577CW

2.08 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 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 C 1136.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 - 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.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - b. Venture Tape; 1506 CW NS.
 - 2. Width: 2 inches.
 - 3. Thickness: 6 mils.
 - 4. Adhesion: 64 ounces force/inch in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch in width.
- D. Self-Adhesive Outdoor Jacket Tape: Multi-layered laminate coated, zero permeability tape matching field-applied jacket with acrylic adhesive.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Venture Tape; 1577 CW.

2.09 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick,

3/4 inch wide with wing or closed seal.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Products; Bands.
- b. PABCO Metals Corporation; Bands.
- c. RPR Products, Inc.; Bands.

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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
- 2) GEMCO; Perforated Base.
- 3) Midwest Fasteners, Inc.; Spindle.

- 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) GEMCO; Nylon Hangers.
- 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

- 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.

- 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
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. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

2.10 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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, soften, or otherwise attack insulation or jacket in either wet or dry state.
- 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. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- 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 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.
 - 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.
 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 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- 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 like 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. Manholes.
 5. Handholes.
 6. Cleanouts.

3.03 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 Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. 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.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Pipe: Install insulation continuously through floor penetrations.
 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

3.04 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.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using closed cell fitting insulation or mitered fittings made from same material and density as 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 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 used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 two 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 and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 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.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, expansion tank, air separator, pumps, and other equipment. 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.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.05 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- 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 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 mitered sections of pipe insulation.
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 preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed 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.

3.06 MINERAL-FIBER INSULATION INSTALLATION

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 factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but 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 preformed 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 mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as 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 preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered 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.

E. Blanket 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 and 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 1 edge and 1 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 shall 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 2 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.

F. 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 and 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 1 edge and 1 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 shall 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 2 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.

3.07 POLYSTYRENE INSULATION INSTALLATION

A. 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 and percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3.08 RIGID PHENOLIC INSULATION INSTALLATION

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 factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but 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 preformed 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 Fiberglass 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 preformed sections of same material as 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 preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered 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.

3.09 FIELD-APPLIED JACKET INSTALLATION

A. 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

- B. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.
- C. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.
- D. Where PVDC jackets are indicated, install as follows:
 - 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 - 2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 - 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 - 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 - 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.
- E. Where Self-Adhesive Outdoor Jackets are indicated, install as follows:
 - 1. Install jacket in accordance with the manufacturer's published installation instructions.

3.10 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.11 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply air.
2. Outdoor, exposed supply and exhaust.

B. Items Not Insulated:

1. Exposed supply air duct
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Fiberglass blanket, 2-1/2 inches thick and 0.75-lb/cu. ft. nominal density (Minimum R-5).
- B. Exposed, Outdoor-Air Duct and Plenum Insulation: Fiberglass board, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- C. Concealed, Exhaust-Air Duct and Plenum Insulation, within 10 feet of building exit: Mineral-fiber blanket, 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

3.13 ABOVEGROUND, OUTDOOR DUCT AND PLENUM 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. Exposed, Supply-Air Duct and Plenum Insulation:
 1. Polystyrene 2 inches thick (Minimum R-8) for unlined duct.
 2. Polystyrene 1 inch thick (Minimum R-5) for duct lined with 1-1/2 inches thick internal liner.
- C. Exposed, Exhaust-Air Duct and Plenum Insulation:
 1. Polystyrene 2 inches thick (Minimum R-8) for unlined duct.
 2. Polystyrene 1 inch thick (Minimum R-5) for duct lined with 1-1/2 inches thick internal liner.

3.14 OUTDOOR, 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. Ducts and Plenums, Exposed:
 1. Self-adhesive outdoor jacket.

3.15 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.

3.16 INDOOR PIPING INSULATION SCHEDULE

- A. Condenser Water Pipe: Insulation shall be one the following:
 - 1. Phenolic: 1 inch thick.
 - 2. Mineral-Fiber, Preformed Pipe Insulation: 1 inch thick.
- B. Refrigerant Suction, Liquid and Hot-Gas Piping:
 - 1. 1-1/2" and smaller: Flexible Elastomeric Pipe Insulation: 1/2 inch thick.
 - 2. Larger than 1-1/2": Flexible Elastomeric Pipe Insulation: 1 inch thick.
- C. Moisture Condensate Piping: Flexible Elastomeric Pipe Insulation, 1/2 inch thick.

3.17 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. Indoor Piping:
 - 1. Piping exposed in the mechanical rooms shall be have factory applied ASJ covered with PVC jacket 20 mils thick

3.18 OUTDOOR PIPING INSULATION SCHEDULE

- A. Condenser Water Pipe: Insulation shall be the following:
 - 1. Phenolic: 1-1/2 inch thick.

3.19 OUTDOOR, 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.
 - 1. Provide corrugated aluminum jacket .020 inches thick on all outdoor condenser water piping.
- B. Ducts and Plenums, Exposed:
 - 1. Self-adhesive outdoor jacket.

END OF SECTION

SECTION 23 08 00
COMMISSIONING OF HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. HVAC commissioning description.
 - 2. HVAC commissioning responsibilities.
- B. Related Sections:
 - 1. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: For requirements and procedures concerning testing, adjusting, and balancing of mechanical systems.
 - 2. Section 23 09 00 - Instrumentation and Control for HVAC: Submittal and training requirements.
 - 3. Section 23 09 23 - Direct-Digital Control System for HVAC: Submittal, training, and programming requirements.
 - 4. Section 23 09 53 - Pneumatic and Electric Control System for HVAC: Submittal and training requirements.
 - 5. Section 23 33 00 - Air Duct Accessories: Product requirements for ductwork test holes.
 - 6. Section 25 50 00 - Integrated Automation Facility Controls: Submittal, training, and programming requirements.

1.02 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE Guideline 1 - The HVAC Commissioning Process.
- B. Building Commissioning Association:
 - 1. BCA - Commissioning Handbook.
- C. National Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Building Systems Commissioning.
- D. Testing Adjusting and Balancing Bureau:
 - 1. TABB - Commissioning Manual.

1.03 COMMISSIONING DESCRIPTION

- A. HVAC commissioning process includes the following tasks:
 - 1. Testing and startup of HVAC equipment and systems.
 - 2. Equipment and system verification checks.
 - 3. Assistance in functional performance testing to verify testing and balancing, and equipment and system performance.
 - 4. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
 - 5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
 - 6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
 - 7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.

8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
 9. Provide training for systems specified in this Section with coordination by Commissioning Authority.
- B. Equipment and Systems to Be Commissioned:
1. New HVAC systems that were installed under this Contract.
- C. The following is a partial list of equipment that may be included in this HVAC Commissioning:
1. Packaged roof top air conditioning units.
 2. Electric terminal heating equipment.
 3. Variable volume terminal units.
 4. Fans.
 5. Automatic HVAC control system.
 6. Testing, Adjusting and Balancing work.
- D. Perform seasonal function performance tests for the following equipment and systems:
1. Heating equipment during heating season.
 2. Cooling equipment during cooling season.

1.04 COMMISSIONING SUBMITTALS

- A. Section 01 91 00 - Commissioning: Requirements for commissioning submittals.
- B. Draft Forms: Submit draft of system verification form and functional performance test checklist.
- C. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified.
- D. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.
- C. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with ASHRAE Guideline 1 requirements.

1.07 COMMISSIONING RESPONSIBILITIES

- A. Equipment or System Installer Commissioning Responsibilities:
1. Attend commissioning meetings.
 2. Ensure temperature controls installer performs assigned commissioning responsibilities as specified below.
 3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.

4. Provide instructions and demonstrations for Owner's personnel.
5. Ensure subcontractors perform assigned commissioning responsibilities.
6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
7. Develop startup and initial checkout plan using manufacturer's startup procedures and functional performance checklists for equipment and systems to be commissioned.
8. During verification check and startup process, execute HVAC related portions of checklists for equipment and systems to be commissioned.
9. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
10. Provide manufacturer's representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
12. Provide personnel to assist Commissioning Authority during equipment or system verification checks and functional performance tests.
13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
15. Perform verification checks and startup on equipment and systems as specified.
16. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.
17. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
18. Conduct HVAC system orientation and inspection.

B. Temperature Controls Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Review design for ability of systems to be controlled including the following:
 - a. Confirm proper hardware requirements exists to perform functional performance testing.
 - b. Confirm proper safeties and interlocks are included in design.
 - c. Confirm proper sizing of system control valves and actuators and control valve operation will result capacity control identified in Contract Documents.
 - d. Confirm proper sizing of system control dampers and actuators and damper operation will result in proper damper positioning.
 - e. Confirm sensors selected are within device ranges.
 - f. Review sequences of operation and obtain clarification from Architect/Engineer.
 - g. Indicate delineation of control between packaged controls and building automation system, listing BAS monitor points and BAS adjustable control points.
 - h. Provide written sequences of operation for packaged controlled equipment. Equipment manufacturers' stock sequences may be included, when accompanied by additional narrative to reflect Project conditions.
3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other HVAC sections.
4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Architect/Engineer.
5. Inspect check and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.

6. Perform training sessions to instruct Owner's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan and requirements of Section 23 09 23.
 7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
 8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.
 9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
 10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.
- C. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:
1. Attend commissioning meetings.
 2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes. Repeat sample of 10 percent of measurements contained in testing, adjusting, and balancing report as selected by Commissioning Authority.
 3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.08 COMMISSIONING MEETINGS

- A. Section 01 91 00 - Commissioning: Requirements for commissioning meetings.
- B. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.09 SCHEDULING

- A. Section 01 32 16 - Construction Progress Schedule: Requirements for scheduling.
- B. Prepare schedule indicating anticipated start dates for the following:
 1. Piping system pressure testing.
 2. Piping system flushing and cleaning.
 3. Ductwork cleaning.
 4. Ductwork pressure testing.
 5. Equipment and system startups.
 6. Automatic temperature control system checkout.
 7. Testing, adjusting, and balancing.
 8. HVAC system orientation and inspections.
 9. Operation and maintenance manual submittals.
 10. Training sessions.
- C. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.
- D. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy or use.

1.10 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Notify Commissioning Authority minimum of four weeks in advance of the following:
 1. Scheduled equipment and system startups.

2. Scheduled automatic temperature control system checkout.
 3. Scheduled start of testing, adjusting, and balancing work.
- C. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install additional balancing dampers, balancing valves, access doors, test ports, and pressure and temperature taps required by commissioning plan.
- B. Place HVAC systems and equipment into full operation and continue operation during each working day of commissioning.
- C. Install replacement sheaves and belts to obtain system performance, as requested by Commissioning Authority.
- D. Install test holes in ductwork and plenums as requested by Commissioning Authority for taking air measurements. Refer to Section 23 33 00.
- E. Prior to start of functional performance test, install replacement filters in equipment.

3.02 FIELD TESTS AND INSPECTIONS

- A. Seasonal Sensitive Functional Performance Tests:
 1. Test heating equipment at winter design temperatures.
 2. Test cooling equipment at summer design temperatures.
 3. Participate in testing delayed beyond Final Completion to test performance at peak seasonal conditions.
- B. Be responsible to participate in initial and alternate peak season test of systems required to demonstrate performance.
- C. Occupancy Sensitive Functional Performance Tests:
 1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.
 2. Participate in testing delayed beyond Final Completion to test performance with actual occupancy conditions.

END OF SECTION

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

1.02 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and shall be used in conjunction with this Section as a part of the Contract Documents.

1.03 WORK INCLUDED

- A. Furnish a totally NATIVE BACnet-based system, including an operator's workstation using Microsoft Windows 8 as the operating system and shall be based on a distributed control system in accordance with this specification. The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135–2001, BACnet. All workstations and controllers, including application specific controllers, shall be native BACnet devices. No gateways shall be used for communication to controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.
- B. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. All controllers used shall have the BACnet Testing Laboratories (BTL) stamp of conformance to the BACnet communications protocol.
- C. Wireless sensors and communication are not acceptable.
- D. The control system shall accommodate simultaneous multiple user operation limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to log onto any work-station on the control system and have access to all appropriate data.
- E. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. In the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.

- F. Provide a comprehensive operator and technician training program as described herein.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's standard specification data sheets for all hardware and software to be provided.
- B. Shop Drawings:
 - 1. Schematic flow diagrams.
 - 2. Power, signal, and control wiring diagrams.
 - 3. Details of control panel faces.
 - 4. Damper schedule.
 - 5. Valve schedule.
 - 6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
 - 7. Control System Software: Schematic diagrams, written descriptions, and points list.
- C. Project Record Drawings - As built version of the submittal shop drawings.
- D. Testing and Commissioning Reports and Checklists.
- E. Operating and Maintenance (O & M) Manual - These shall be as-built versions of the submittal product data.

1.05 WARRANTY

- A. Labor and materials for control system specified shall be warranted free from defects for a period of twelve (12) months from date of substantial completion. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner.

1.06 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alerton BACTalk
 - 2. Siemens Apogee
 - 3. Automated Logic WebCTRL
 - 4. Johnson Controls Metasys

2.02 OPERATOR INTERFACE

- A. Furnish one PC based work-station as shown on the system drawings. Each work-station shall be able to access all information in the system. The work-stations shall reside on the same high-speed network as the building controllers.

2.03 AUTOMATION SYSTEM COMMUNICATIONS

- A. All communication with operator workstation, building controllers and all application controllers shall be via BACnet. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz), master slave token passing (MS/TP) LANs, a point-to-point (PTP – RS-232) connection. ARCnet based communication LANs are not acceptable.
 - 1. Each MS/TP LAN must be software configurable from 9.6 to 76.8Kbps.
 - 2. The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).
 - 3. The direct access port must be a female DB-9 connector supporting BACnet temporary PTP connection of a portable BACnet operator terminal at 9.6 to 115.2 Kbps over RS-232 null modem cable.
- B. BACnet Conformance
 - 1. Building Controllers shall as a minimum support Point-to-Point (PTP), MS/TP and/or Ethernet (10Base-T or 100Base-TX) BACnet LAN types. They shall communicate directly via these approved BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types.
 - 2. All controllers used shall have the BACnet Testing Laboratories (BTL) stamp of conformance to the BACnet communications protocol.

2.04 OPERATOR WORK-STATION

- A. Personal Computer: Furnish IBM compatible PCs as shown on the drawings, as well as all required serial, parallel and network communication ports and all cables.
- B. CPU shall be a minimum of an Intel Pentium and operate at a minimum of 2.8 GHz. A minimum of 1 GB of RAM, one CDRW drive, and a 90 GB hard disk.
- C. A keyboard and two button mouse will also be provided.
- D. The PC shall have a minimum of a 19" Flat Screen monitor.
- E. The PC shall an Ethernet port for connection to owner's LAN.

2.05 SYSTEM SOFTWARE

A. Operating System: Microsoft Windows 8.

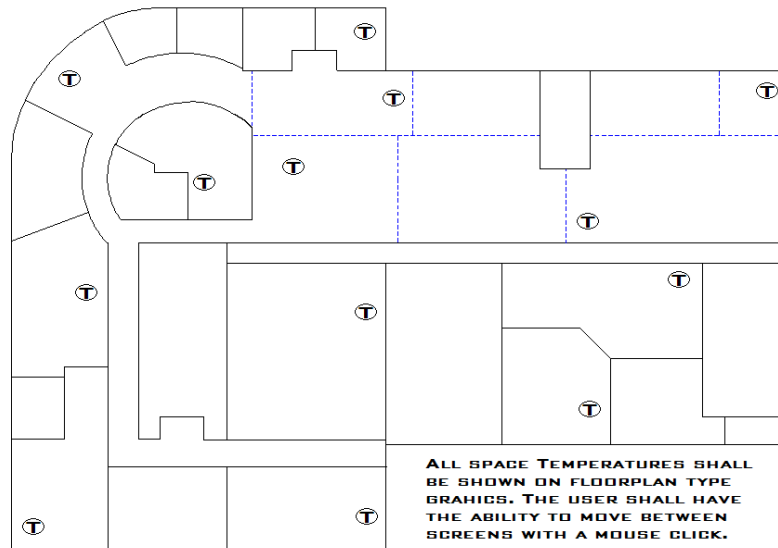
B. System Graphics

1. The Operator Work-station software shall be graphically oriented. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on line. An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files.
 - a. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system that uses the mouse
 - b. Graphics Library. Furnish a complete library of standard HVAC equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators as well as standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and duct-work.
 - c. Engineering Units. Unit selection shall be able to be customized by locality to select the desired units for each measurement. Engineering units on this project shall be Standard Inch Pound.
2. Typical Building Graphic Display
 - a. An overall building graphical display shall be provided as a roadmap for the system. From this graphic, the operator shall have the capability of viewing operating schedules, RTU and floor plan graphics via mouse clicks. All graphical displays shall have links to other associated graphic displays for the system.



3. Typical Floor Plan Graphics

- a. Graphics to show all space temperatures in floor plan type graphical displays. The operator shall have the capability of viewing the detailed graphic for the terminal box serving the area or associated RTU from a simple mouse click on the specific area.



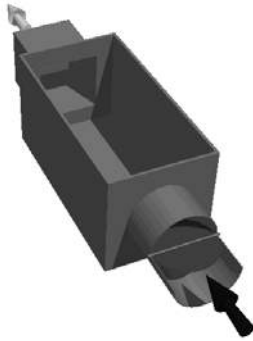
4. Typical AHU Graphics

- a. Graphics to show all information related to the operation of the AHU including temperatures, pressures, airflows, operation setpoints, damper positions, valve positions, cooling stages, fan speed, fan status, filter status, alarms, etc. as required for the project.



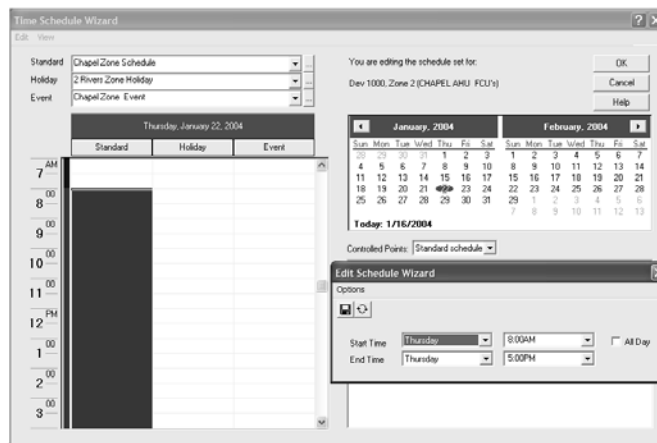
5. Typical VAV Box Graphics

- a. Graphics to show all information related to the operation of the VAV including temperatures, pressures, airflows, operating setpoints, damper positions, valve positions, heat stages, fan status, alarms, etc. as required for the project.



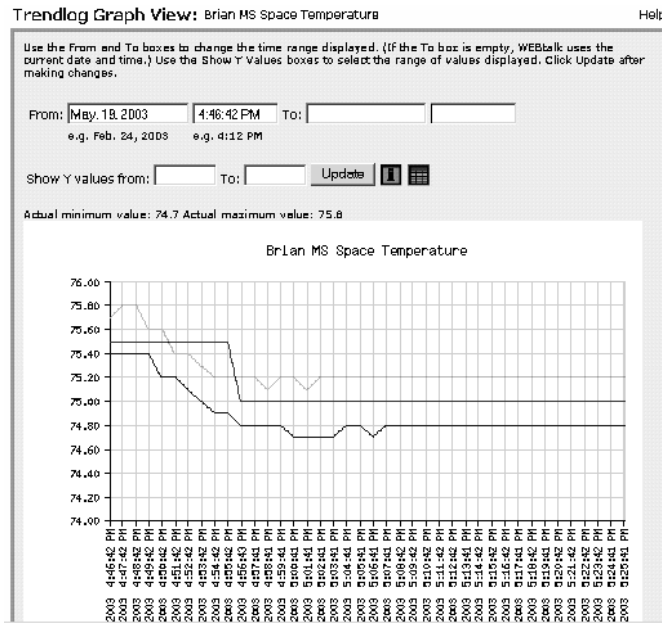
6. Typical System Scheduling Graphics

- a. HVAC System scheduling shall be performed from a graphical user interface which depicts monthly calendars with normal, holiday and exception schedules.



7. Typical System Trending Graphics

- a. The BAS System shall provide the operator with the capability to setup trend graphs for points (i.e. temperatures, pressures, damper positions, etc.) on the system.



- C. System Applications: Work-station shall provide operator interface and off-line storage of system information. Provide the following applications at the work-station.
- D. Automatic System Database Save and Restore: Each work-station shall store on the hard disk a copy of the current database of each building controller which shall be updated whenever a change is made in any panel in the system.
- E. Manual Database Save and Restore: A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media.
- F. System Configuration: The work-station software shall provide a graphical method of configuring the system. The user with proper security shall be able to add new devices, assign modems to devices, and obtain a visual riser diagram of the system, allowing for future system changes/additions.
- G. Context sensitive on-line help to assist the operator in operation and editing of the system.
- H. Security: Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall set passwords and security levels for all other operators to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object.
- I. System Diagnostics: The system shall automatically monitor the operation of all work-stations, printers, modems, network connections, building management panels, and controllers, annunciating the failure of any device to the operator.
- J. Alarm Processing: Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system. Actions shall include logging, printing, starting

programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by work-station and time of day.

- K. Trend Logs: The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, and once a month shall be selectable. Trend data shall be able to be viewed and printed from the operator interface software. They shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages.
- L. Alarm and Event Log: The operator shall be able to view all logged system alarms and events from any location in the system. All alarms and events that have not been cleared by the operator shall be archived to the hard disk.
- M. Object and Property Status and Control shall provide a method for the operator with proper password protection to view, and edit if applicable, the status of any object and property in the system.
- N. Clock Synchronization: The real time clocks in all building control panels and work-stations shall be synchronized on command of an operator. The system shall automatically adjust for daylight savings and standard time if applicable.
- O. Reports and Logs: Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing.
 - 1. Custom Reports to easily define any system data into a daily, weekly, monthly, or annual report.
 - 2. Reports showing current scheduling of equipment.
- P. Work-station Applications Editors: PC work-station shall support full screen editing of all system applications.
- Q. Controller: An editor for each type controller and application shall allow the operator with proper password to view and change the configuration, name, control parameters, and system set-points.
- R. Scheduling: An editor to provide a monthly calendar for each schedule, clearly showing exception schedules and holidays. Provide a method for allowing several related objects to follow a schedule. The advance and delay time for each object shall be adjustable from this master schedule. Schedules shall be able to be easily copied between objects and/or dates.
- S. Equipment Coordination: Provide a full screen editor that allows equipment to be grouped for proper operation as specified in the sequence of operations.
- T. Custom Application Programming: Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating.

- U. System Security: User access shall be secured using individual security passwords and user names that restrict the user to only the objects, applications, and system functions as assigned by the system manager.
- V. Scheduling: Provide the capability to schedule each object or group of objects in the system including the capability for start, stop, optimal start, optimal stop, and night economizer actions. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of weekly schedules, exception schedules, holiday schedules and optimal start/stop.
- W. Alarm Reporting: Alarms shall be routed to the appropriate work-stations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages and display graphics.
- X. Remote Communications: The system shall have the ability to dial out in the event of an alarm to receivers including PC Workstations, and Alpha-numeric pagers.
- Y. PID Control: A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. to calculate a time-varying analog value used to position an output or stage a series of outputs.
- Z. Staggered Start: This application shall prevent all controlled equipment from simultaneously restarting after a power outage.
- AA. Anti-Short Cycling: All binary output points shall be protected from short cycling by allowing selectable minimum on and off-time.

2.06 BUILDING CONTROLLERS

- A. General: The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the global strategies described in System software section. Data shall be shared between networked Building Controllers.
- B. The controller shall provide a communications port for connection of the Portable Operators Terminal using Point to Point BACnet physical/data link layer protocol or a connection to the inter-network.
- C. All controllers used shall have the BACnet Testing Laboratories (BTL) stamp of conformance to the BACnet communications protocol.
- D. Communications: Each Building Controller shall reside on a BACnet inter-network using the ISO 8802-3 (Ethernet) Physical/Data Link layer protocol. Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers.
- E. Memory: The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

2.07 CUSTOM APPLICATION CONTROLLERS

- A. General - Custom Application controllers (CAC) are microprocessor-based DDC controllers which are fully user programmable. They are customized for operation within the confines of the equipment they are designed to serve. Each CAC shall be capable of stand-alone

operation and shall continue to provide control functions without being connected to the network. All controllers used shall have the BACnet Testing Laboratories (BTL) stamp of conformance to the BACnet communications protocol. All communications with global controllers shall be via BACnet over master slave token passing (MS/TP) LANs.

- B. Controller hardware shall be suitable for the anticipated ambient conditions. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA Type 4 waterproof enclosures, and shall be rated for operation at -40 F to 150 F. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32 F to 120 F.

2.08 APPLICATION SPECIFIC CONTROLLERS

- A. General - Application specific controllers (ASC) are microprocessor-based DDC controllers which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network. All controllers used shall have the BACnet Testing Laboratories (BTL) stamp of conformance to the BACnet communications protocol. All communications with global controllers shall be via BACnet over master slave token passing (MS/TP) LANs.
- B. Environment - Controllers used outdoors and/or in wet ambient shall be mounted within NEMA Type 4 waterproof enclosures, and shall be rated for operation at -40 F to 150 F. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32 F to 120 F.

2.09 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
 - 1. Accuracy: Plus or minus 0.5 deg F at calibration point.
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 - 4. Averaging Elements in Ducts: Use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
 - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
 - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: Exposed.
 - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:

1. Accuracy: Plus or minus 0.2 percent at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
4. Averaging Elements in Ducts: Use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: Exposed.
7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Accuracy: 2 percent full range with linear output.
2. Room Sensor Range: 20 to 80 percent relative humidity.
3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: Exposed.
4. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
5. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.
6. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg.
 - d. Duct Static-Pressure Range: 0- to 5-inch wg.
2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.

3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
 4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
 5. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.
- F. Room Sensor Cover Construction: Manufacturer's standard locking covers.
1. Set-Point Adjustment: Concealed.
 2. Set-Point Indication: Concealed.
 3. Thermometer: Exposed.
- G. Room sensor accessories include the following:
1. Insulating Bases: For sensors located on exterior walls.
 2. Adjusting Key: As required for calibration and cover screws.

2.10 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.11 THERMOSTATS

- A. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
- B. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 - 2. Selector Switch: Integral, manual on-off-auto.

2.12 HUMIDISTATS

- A. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.13 GAS DETECTION EQUIPMENT

- A. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F; with 2 factory-calibrated alarm levels at 50 and 100 ppm.
- B. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output, for wall mounting.
- C. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.
- D. Field Service Tool
 - 1. Field service tool shall allow technician to view and modify all setpoints and tuning parameters stored in application controller. In addition, technician shall be able to view status of all inputs and outputs on digital readout. Each piece of data shall have a data code associated with it that is customizable.
 - 2. Field service tool shall plug into wall sensor and provide all the functionality specified. Operator workstation shall include the capability to disable operation of the field service tool.
 - 3. Provide one Field Service Tools for this project.
- E. Network Connection Tool
 - 1. Network connection tool shall allow technician to connect a laptop to any MS/TP network or at any MS/TP device and view and modify all information throughout the entire BACnet network. Laptop connection to tool shall be via Ethernet or PTP.
 - 2. Provide quick connect to MS/TP LAN at each controller. Tool shall be able to adjust to all MS/TP baud rates specified in the BACnet standard.
 - 3. Provide one Network Connection Tools for this project.

2.14 ELECTRONIC ACTUATORS AND VALVES

- A. Quality Assurance for Actuators and Valves
 - 1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
 - 2. NEMA 2 rated enclosures for inside mounting. Provide additional weather shield for outside mounting.
 - 3. Two year manufacturer's warranty.
- B. Execution Details for Actuators and Valves
 - 1. Furnish a Freeze-stat and install "Hard Wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
 - 2. Each DDC analog output point shall have an actuator feedback signal, independent of control signal, wired and terminated in the control panel for true position information and troubleshooting. Or the actuator feedback signal may be wired to the DDC as an analog input for true actuator position status.
 - 3. VAV box damper actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
 - 4. Primary valve control shall be Analog (2-10vdc, 4-20ma).
- C. Actuators for Dampers and Control Valves ½" to 6" shall be Electric unless otherwise specified. Provide actuators as follows:
 - 1. UL Listed Standard 873 and Canadian Standards association Class 481302 shall certify Actuators.
 - 2. NEMA 2 rated actuator enclosures for inside mounting. Provide additional weather shield for outside mounting.
 - 3. Two year manufacturer's warranty.
 - 4. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
 - 5. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator.
 - 6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
 - 7. A push button gearbox release shall be provided for all non-spring actuators.
 - 8. Modulating actuators shall be 24Vac and consume 10VA power or less.
 - 9. Conduit connectors are required when specified and when code requires it.
- D. Damper Actuator Schedule
 - 1. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
 - 2. Economizer Actuators shall utilize Analog control 2-10 VDC, Floating control is not acceptable.

3. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
4. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details).

E. Actuator Mounting for Damper arrangements shall comply with the following:

1. Damper Actuators: Shall not be installed in the air stream
2. A weather shield shall be used if actuators are located outside. For Damper Actuators use clear plastic enclosure.
3. Damper or valve actuator ambient temperature shall not exceed 122 degrees F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary
4. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.
5. Damper mounting arrangements shall comply to the following:
 - a. The ventilation subcontractor shall furnish and install damper channel supports and sheet metal collars.
 - b. No jack shafting of damper sections shall be allowed.
 - c. Multi-section dampers shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per section.

F. Valve Actuators ½" to 6"

1. Mechanical spring shall be provided on all actuators for pre-heat coil and actuators for AHU heating or cooling coil when units are mounted outside. See plans for fail-safe flow function: Normal Open or Normal Closed. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
2. All zone service actuators shall be non-spring return unless otherwise specified.
3. The valve actuator shall be capable of providing the minimum torque required for proper valve close off for the required application.
4. All control valves actuators shall have an attached 3-foot cable for easy installation to a junction box.
5. Override handle and gearbox release shall be provided for all non-spring return valve actuators.

G. Control Dampers. The BAS contractor shall furnish and size all automatic control dampers unless provided with packaged equipment. The Mechanical shall install all dampers unless provided with packaged equipment.

1. All dampers used for modulating service shall be opposed blade type arrange for normally open or normally closed operation as required. The damper is to be sized so that when wide open the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
2. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
3. Damper linkage hardware shall be constructed of aluminum or corrosion resistant zinc & nickel-plated steel and furnished as follows:
4. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.
5. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For Single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.
6. Damper manufacturer shall supply alignment plates for all multi-section dampers.

H. Control Damper Sizing

1. Size damper sections based on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general:
 - a. Damper section shall not exceed 24 ft-sq. with face velocity ≤ 1500 FPM.
 - b. Damper section shall not exceed 18 ft-sq. with face velocity ≤ 2500 FPM.
 - c. Damper section shall not exceed 13 ft-sq. with face velocity ≤ 3000 FPM.
2. Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.
3. Multiple section dampers of three or more sections wide shall be arranged with a 3-sided vertical channel (8" wide by 6" deep) within the duct or fan housing and between adjacent damper sections. Vertical channel shall be anchored at the top and bottom to the fan housing or building structure for support. The sides of each damper frame shall be connected to the channels. Holes in the channel shall allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Open side of channel shall be faced down stream of the airflow, except for exhaust air dampers.
4. Multiple section dampers to be mounted flush within a wall or housing opening shall receive either vertical channel supports as described above or sheet metal standout collars. Sheet metal collars (12" minimum) shall bring each damper section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.

I. Control Valves ½" to 6": The BAS contractor shall furnish all specified motorized control valves and actuators. BAS contractor shall furnish all control wiring to actuators. The Mechanical contractor shall install all valves. Equal Percentage control characteristic shall be provided for all water coil control valves. Linear valve characteristic is acceptable for 3-way valves 2½ inch and above.

1. Characterized Control Valves shall be used for hydronic heating or cooling applications and small to medium AHU water coil applications to 100GPM. Actuators are non-spring return for terminal unit coil control unless otherwise noted. If the coil is exposed to the Outside Air stream then see plans for Spring Return requirement.
 - a. Leakage is Zero percent, Close-off is 200psi, Maximum differential is 30psi. Rangeability is 500:1.

- b. Valves 1/2 inch through 2 inches shall be nickel-plated forged brass body, NPT screw type connections.
 - c. Valves 1/2 inch through 1-1/4 inches shall be rated for ANSI Class 600 working pressure. Valves 1-1/2 inch and 2 inches shall be rated for ANSI Class 400 working pressure.
 - d. The operating temperature range shall be 0° to 250° F.
 - e. Stainless steel ball & stem shall be furnished on all modulating valves.
 - f. Seats shall be fiberglass reinforced Teflon.
 - g. Two-way and three-way valves shall have an equal percentage control port. Full stem rotation is required for maximum flow to insure stable BTU control of the coil.
 - h. Three-way valve shall be applicable for both mixing and diverting.
 - i. The characterizing disc is made of TEFZEL and shall be keyed and held secure by a retaining ring.
 - j. The valves shall have a blowout proof stem design.
 - k. The stem packing shall consist of 2 lubricated O-rings designed for on-off or modulating service and require no maintenance.
 - l. The valves shall have an ISO type, 4-bolt flange, for mounting actuator in any orientation parallel or perpendicular to the pipe.
 - m. A non-metallic thermal isolation adapter shall separate valve flange from actuator.
 - n. One fastening screw shall secure the direct coupling of the thermal isolation adapter between the actuator and the valve. This will prevent all lateral or rotational forces from affecting the stem and it's packing O-rings.
2. Globe valves 1/2" to 2" shall be used for steam control or water flow applications.
- a. Valves shall be bronze body, NPT screw type, and shall be rated for ANSI Class 250 working pressure.
 - b. Valves 1/2 inch (DN15) through 2 inches (DN50) with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (.1%).
 - c. The operating temperature range shall be 20° to 280° F.
 - d. Spring loaded TFE packing shall protect against leakage at the stem.
 - e. Two-way valves shall have an equal percentage control port.
 - f. Three-way valves shall a linear control and bypass port.
 - g. Mixing and diverting valves must be installed specific to the valve design.
3. Globe Valve 2 1/2 to 6"
- a. Valves 2-1/2 inch (DN65) through 6 inches (DN150) shall be iron body, 125 lb. flanged with Class III (.1%) close-off leakage at 50 psi differential.
 - b. Valves with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (.1%).
 - c. Flow type for two-way valves shall be equal percentage. Flow type for three-way valves shall be linear.
 - d. Mixing and diverting valves must be installed specific to the valve design.
4. Butterfly valves
- a. Body is Cast Iron.

- b. Disc is Aluminum Bronze standard.
- c. Seat is EPDM Standard.
- d. Body Pressure is 200 psi, -30F to 275F.
- e. Flange is ANSI 125/250.
- f. Media Temperature Range is -22F to 240F.
- g. Maximum Differential Pressure is 200 psi for 2" to 6" size.

J. Control Valve Sizing

- 1. On/Off Control Valves shall be line size.
- 2. Modulating Control Valve Body Size may be reduced at most two pipe sizes from the line size or not less than ½ the pipe size. The BAS contractor shall size all water coil control valves for the application as follows:
 - a. Booster-heat valves shall be sized not to exceed 4-9psi differential pressure. Size valve for 50% Valve Authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - b. Primary valves shall be sized not to exceed 5-15psi differential pressure. Size valve for 50% Valve Authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - c. Butterfly valves shall be sized for modulating service at 60-70-degree rotation. Design velocity shall be 12 feet per second or less when used with standard EPDM seats.

K. Valve Mounting arrangements shall comply with the following:

- 1. Unions shall be provided on all ports of two-way and three-way valves.
- 2. Install three-way equal percentage Characterized Control valves in a mixing configuration with the "A" port piped to the coil.
- 3. Install 2½ inch and above, Three-Way globe valves, as manufactured for mixing or diverting service to the coil.

2.15 FLOW METERS

A. ONICON Model F-3500 Insertion Electromagnetic Flow Meter:

- 1. Insertion type flow meters shall be provided complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand-insertable up to 400 psi.
- 2. For installations in non-metallic pipe, install grounding rings or probes.
- 3. Materials of construction for wetted metal components shall be 316 SS.
- 4. The flow meter shall average velocity readings from two sets of diametrically opposed electrodes.
- 5. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST. A certificate of calibration shall be provided with each flow meter. Accuracy shall be within ± 1% of rate from 2-20 ft/s. Overall turndown shall exceed 100:1.
- 6. Output signals shall be completely isolated and shall consist of the following: (1) analog output; 4-20mA, 0-10V, or 0-5V jumper selectable, (1) scalable dry contact output for

totalization, and (1) high resolution frequency output for use with peripheral devices such as an ONICON display module or Btu meter.

2.16 ENCLOSURES

- A. All controllers, power supplies and relays shall be mounted in enclosures.
- B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
- C. Enclosures shall have hinged, locking doors.
- D. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8" thick sized appropriately to make label easy to read.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the owners' representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.

3.02 INSTALLATION (GENERAL)

- A. Install in accordance with manufacturer's instructions.
- B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

3.03 LOCATION AND INSTALLATION OF COMPONENTS

- A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
- B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture and high or low temperatures.
- C. Identify all equipment and panels. Provide permanently mounted tags for all panels.
- D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections—sized to suit pipe diameter without restricting flow.

3.04 INTERLOCKING AND CONTROL WIRING

- A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 16 and all national, state and local electrical codes.
- B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
- C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
- D. Provide auxiliary pilot duty relays on motor starters as required for control function.
- E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings—coordinate with electrical contractor.
- F. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring is to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum rated cable (without conduit).

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 6. Test each system for compliance with sequence of operation.
 - 7. Test software and hardware interlocks.
- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.

4. Check instrument tubing for proper fittings, slope, material, and support.
 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 6. Check temperature instruments and material and length of sensing elements.
 7. Check control valves. Verify that they are in correct direction.
 8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
 9. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.06 TRAINING

- A. Provide application engineer to instruct owner in operation of systems and equipment.
- B. Provide system operator's training to include (but not limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands and request of logs. Provide this training to a minimum of 3 persons.
- C. Provide on-site training above as required, up to 16 hours as part of this contract.
- D. Provide tuition for at least one individual for a one-week factory training class. If applicable, costs for travel, lodging and meals will be the responsibility of the Owner.

3.07 DEMONSTRATION

- A. Provide systems demonstration under provisions of Section 15 01 0.
- B. Demonstrate complete operating system to owner's representative.
- C. Provide certificate stating that control system has been tested and adjusted for proper operation.

END OF SECTION

SECTION 23 09 35

VARIABLE-FREQUENCY MOTOR DRIVES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.
- B. See Division 26 Section "Motor-Control Centers" for VFCs installed in motor-control centers.

1.02 DEFINITIONS

- A. BAS: Building automation system.
- B. CE: Conformance Europeene (European Compliance).
- C. CPT: Control power transformer.
- D. EMI: Electromagnetic interference.
- E. IGBT: Insulated-gate bipolar transistor.
- F. LAN: Local area network.
- G. LED: Light-emitting diode.
- H. MCP: Motor-circuit protector.
- I. NC: Normally closed.
- J. NO: Normally open.
- K. OCPD: Overcurrent protective device.
- L. PID: Control action, proportional plus integral plus derivative.
- M. PWM: Pulse-width modulated.
- N. RFI: Radio-frequency interference.
- O. VFC: Variable-frequency motor controller.

1.03 SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.

- B. Shop Drawings: For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
 - 1. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.
- C. Product certificates.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Operation and maintenance data.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
- 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 NFPA 70.
- D. IEEE Compliance: Fabricate and test VFC according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide ABB ACH550 E-Clipse or comparable product by one of the following:
 - 1. Danfoss Inc.; Danfoss Drives Div.
 - 2. Yaskawa Electric America, Inc; Drives Division.
- B. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
- C. Application: variable torque.
- D. VFC Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection,

protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
 2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- E. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- F. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- G. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFC input voltage rating.
 2. Input AC Voltage Unbalance: Not exceeding 5 percent.
 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 4. Minimum Efficiency: 96 percent at 60 Hz, full load.
 5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
 6. Minimum Short-Circuit Current (Withstand) Rating: 100 kA.
 7. Ambient Temperature Rating: Not less than 14 deg F and not exceeding 104 deg F.
 8. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F.
 9. Humidity Rating: Less than 95 percent (noncondensing).
 10. Altitude Rating: Not exceeding 3300 feet.
 11. Vibration Withstand: Comply with IEC 60068-2-6.
 12. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 13. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 14. Speed Regulation: Plus or minus 5 percent.
 15. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
 16. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- H. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
- I. Isolated Control Interface: Allows VFCs to follow remote-control electrical signal over a minimum 40:1 speed range.
- J. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 0.1 to 999.9 seconds.
 4. Deceleration: 0.1 to 999.9 seconds.
 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- K. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 3. Under- and overvoltage trips.
 4. Inverter overcurrent trips.
 5. VFC and Motor Overload/Over temperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC over temperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
 6. Critical frequency rejection, with three selectable, adjustable dead bands.
 7. Instantaneous line-to-line and line-to-ground overcurrent trips.
 8. Loss-of-phase protection.
 9. Reverse-phase protection.
 10. Short-circuit protection.
 11. Motor over temperature fault.
- L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- M. Bidirectional Auto-speed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- P. Integral Input Disconnecting Means and OCPD: NEMA AB 1, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.

2.02 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.
 5. Overcurrent.
 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.

2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
1. Running log of total power versus time.
 2. Total run time.
 3. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
 - a. A minimum of two programmable analog inputs: 0- to 10-V dc or 4- to 20-mA dc.
 - b. A minimum of six multifunction programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
 - a. 0- to 10-V dc.
 - b. 4- to 20-mA dc.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 3. Output Signal Interface: A minimum of two programmable analog output signal(s) (operator-selectable "x"- to "y"-mA dc), which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).
 - f. Set point frequency (Hz).
 - g. Motor Power (kW).
 4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

- a. Motor running.
 - b. Set point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.
- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
 - 1. Number of Loops: One Two.
- G. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarms. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.
 - 1. Network Communications Ports: Ethernet and RS-422/485.
 - 2. Embedded BAS Protocols for Network Communications: ASHRAE 135 BACnet; protocols accessible via the communications ports.

2.03 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Dual 5% equivalent impedance internal reactors.
- B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.04 BYPASS SYSTEMS

- A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
- B. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.
- C. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.
 - 1. Bypass Contactor: Load-break, NEMA-rated contactor.
 - 2. Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.
 - 3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
- D. Bypass Contactor Configuration: Full-voltage (across-the-line) type.
 - 1. NORMAL/BYPASS selector switch.
 - 2. HAND/OFF/AUTO selector switch.
 - 3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
 - 4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

- a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
- 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 50 VA.
- 6. Overload Relays: NEMA ICS 2.

2.05 OPTIONAL FEATURES

- A. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.06 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Other Wet or Damp Indoor Locations: Type 4.
- B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.07 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, type.
 - a. Push Buttons: Covered types; momentary.
 - b. Pilot Lights: LED types; push to test.
 - c. Selector Switches: Rotary type.
- B. Reversible NC/NO bypass contactor auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
 - 1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

- E. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- F. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120 -V ac; obtained from integral CPT.

2.08 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
 - 1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.
 - 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
 - 1. Curbs and roof penetrations are specified in Division 07 Section "Roof Accessories."
 - 2. Structural-steel channels are specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Seismic Bracing: Comply with requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible-switch VFC.
- F. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

- I. Comply with NECA 1.

3.02 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each VFC with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.03 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic control devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
 - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Designer before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. VFCs will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.05 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Designer before increasing settings.
- D. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION

SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.

9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.

1.04 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2010, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2010, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.01 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.

- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) 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. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," 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. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "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."

2.02 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 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. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," 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."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," 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."
 - 1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "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."

2.03 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: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. 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.
- G. 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.

2.04 LISTED DUCTWORK FOR REMOVAL OF GREASE AND SMOKE LADEN VAPORS

- A. The grease duct shall be insulated double-wall factory-built type for use with type I kitchen hoods, as described in NFPA-96 for the transportation of air and grease-laden vapors from commercial cooking operation. The grease duct shall be listed and classified as zero clearance to combustibles and 2-hour fire rated.
 - 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. Schebler Chimney Systems.
- B. The factory-built modular duct shall be laboratory tested and listed in accordance with Underwriters Laboratories Standard UL 1978 for grease duct.
- C. The duct profile shall be a flat oval shape to allow overhead and sidewall clearance when installed. Joint sections shall be a 1/2" flange to flange connection sealed with banded flanges and joint sealant.
- D. Inner shell material shall be type 304 or 316 stainless steel. Inner shell thickness shall be .035". All inner shell seams shall be fully penetration welded the entire length of the pipe section. Riveted, tack or spot-welded seams are not permitted.

- E. Outer shell material shall be aluminized steel with a thickness of .034". Grease duct sections exposed outside shall have an outer shell optional of 304 stainless steel. All outer shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot-welded seams are not permitted.
- F. Between the inner and outer shells there shall be a minimum 4" of low conductivity ceramic fiber insulation. The insulation is to be securely attached to the inner shell with steel straps and insulating pins welded to the inner shell. Stainless steel centering clips shall be welded to the outer shell to maintain the 4" spacing and ensure concentricity of the shells.
- G. Grease duct sections, when installed according to manufacturer's instructions, shall comply with national safety standards and building codes. Duct that terminates above a roof must terminate as required by code or NFPA 211.
- H. Rated for continuous operation at 500 F and intermittent operation at 2000 F.
- I. All components of the grease duct system shall be provided by the manufacturer to ensure the system meets the requirements of the listing including duct supports, guides, fittings, cleanouts, and expansion joints required to install the duct.

2.05 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; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. 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.
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Insulation Pins and Washers:
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-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 or aluminum; 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 2-19, "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. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2,200 fpm.
 7. 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.
 8. 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 2,200 fpm or where indicated.
 9. 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.
 10. 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.

2.06 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 according to 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: 4 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.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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.

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.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.07 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated 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 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "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: Cadmium-plated 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

3.01 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. A maximum 72-inch length of flexible duct may be used to connect low pressure duct to diffusers, grilles, and registers.
- G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- K. 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.
- L. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

- M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines" at the Intermediate Level.

3.02 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 the 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.

3.03 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Installation of factory-built grease duct shall be in accordance with the manufacturer's published installation instructions.
- B. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- C. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- D. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.04 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to 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.

3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "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.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. 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 maximum intervals of 16 feet.
- F. 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.

3.06 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines" at the intermediate level.
- C. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

3.08 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.09 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.
- B. Exposed supply ducts and first 20 feet of discharge supply duct at Variable-Air-Volume Air-Handling Units shall be double wall with 1-1/2-inch insulation and perforated sheet metal inner liner.
- C. Fabricate Rooftop Unit supply and return discharge plenums with minimum 16 ga. galvanized sheet steel
- D. Supply Ducts:
 1. Ducts Connected to Indoor Units and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 12.
 2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 3.
 - c. SMACNA Leakage Class for Round and Flat Oval: 3.
- E. Return Ducts:
 1. Ducts Connected to Rooftop Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 12.
 2. Ducts Connected to Indoor Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.

- c. SMACNA Leakage Class for Round and Flat Oval: 12.

F. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
2. Ducts Connected to Dishwasher Hoods:
 - a. Aluminum sheet.
 - b. Exposed to View: bright finish.
 - c. Concealed: mill finish.
 - d. Welded seams and flanged joints with watertight EPDM gaskets.
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.

G. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

H. Liner:

1. Supply Air Ducts:
 - a. At indoor air-handling units and terminal units, first 10 feet from unit: Fibrous glass, Type I, 1 inch thick.
 - b. At roof top units, first 10 feet from unit: Fibrous glass, Type I, 1-1/2 inch thick.
2. Return Air Ducts
 - a. At indoor air-handling units, first ten feet from unit: Fibrous glass, Type I, 1 inch thick.
 - b. At roof top units serving Theatre, entire length: Fibrous glass, Type I, 1-1/2 inch thick.
3. Return Plenums: Fibrous glass, Type II, 1 inch thick.
4. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

I. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.

- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
- c. Velocity 1500 fpm or Higher:
- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
- a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches > and Larger in Diameter: Standing seam.
- J. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Control dampers.
 - 3. Turning vanes.
 - 4. Duct-mounted access doors.
 - 5. Flexible connectors.
 - 6. Flexible ducts.
 - 7. Duct accessory hardware.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

- 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 AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. 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: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- 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.

2.02 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

- 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. Air Balance Inc.
 - b. Flexmaster U.S.A., Inc.
 - c. McGill AirFlow LLC.
 - d. METALAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Ruskin Company.
- 2. Standard leakage rating, with linkage outside airstream.
- 3. Suitable for horizontal or vertical applications.
- 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - 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.
- 7. Bearings:
 - a. Oil-impregnated bronze.
 - 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: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

- 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. Air Balance Inc.
 - b. Flexmaster U.S.A., Inc.
 - c. McGill AirFlow LLC.
 - d. METALAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames: Hat-shaped, 0.10-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. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Oil-impregnated bronze.
 - 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. 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.

2.03 CONTROL DAMPERS

- 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. Arrow United Industries.
 2. Flexmaster U.S.A., Inc.
 3. Greenheck Fan Corporation.
 4. McGill AirFlow LLC.
 5. METALAIRE, Inc.
 6. Nailor Industries Inc.
 7. NCA Manufacturing, Inc.
 8. Ruskin Company.
- B. Frames:
1. Hat shaped.
 2. Galvanized-steel channels, 0.064 inch thick.
 3. Mitered and welded corners.
- C. Blades:
1. Multiple blade with maximum blade width of 8 inches.
 2. Parallel blade design.
 3. Galvanized steel.
 4. 0.064 inch thick.
 5. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

- 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. Oil-impregnated bronze.
 - 2. 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.
 - 3. Thrust bearings at each end of every blade.

2.04 TURNING VANES

- 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. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- 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 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall.

2.05 FIRS/SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. PHL, Inc.
 - 6. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Integral, factory wired for single-point connection.

- D. Frame: Curtain type with blades inside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- F. Leakage: Class I
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application[with factory-furnished silicone calking].
- I. Damper Motors: [Modulating] [or] [two-position] action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "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 Division 26 Sections.
 - 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 (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
 - 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 (minus 40 deg C).
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
 - 7. Electrical Connection: 24 V.

2.06 DUCT-MOUNTED ACCESS DOORS

- 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. Ductmate Industries, Inc.
 - 2. Flexmaster U.S.A., Inc.
 - 3. Greenheck Fan Corporation.
 - 4. McGill AirFlow LLC.
 - 5. Nailor Industries Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - 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.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.07 FLEXIBLE CONNECTORS

- 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. Duro Dyne Inc.
 - 2. Ventfabrics, Inc.
- 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 inches wide attached to 2 strips of 3-inches 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 lbs/inch in the warp and 360 lbs/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.

2.08 FLEXIBLE DUCTS

- 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. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
- B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; 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/IESNA 90.1-2004.

C. Flexible Duct Connectors:

1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.
2. Non-Clamp Connectors: Liquid adhesive plus tape.

2.09 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

3.01 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.
- 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.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. At duct mounted smoke detectors.
 2. Upstream and downstream from turning vanes.
 3. Control devices requiring inspection.
- F. Install access doors with swing against duct static pressure.
- G. 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.
- H. Install flexible connectors to connect ducts to equipment.

- I. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- J. Connect flexible ducts to metal ducts with liquid adhesive plus tape or draw bands.
- K. Install duct test holes where required for testing and balancing purposes.

3.02 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 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.

END OF SECTION

SECTION 23 34 23
HVAC POWER VENTILATORS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Centrifugal roof ventilators.
 - 2. Centrifugal wall ventilators.
 - 3. Ceiling-mounting ventilators.
 - 4. In-line centrifugal fans.

1.02 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.03 QUALITY ASSURANCE

- A. 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.
- B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.01 CENTRIFUGAL ROOF VENTILATORS

- A. 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Acme Engineering & Mfg. Corp.
 - 2. Carnes Company HVAC.
 - 3. Greenheck.
 - 4. Loren Cook Company.
 - 5. Penn Ventilation.
- D. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- E. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
 - 1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- F. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- G. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust airstream.
- H. Accessories:
 - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 - 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
 - 4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
- I. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 - 1. Configuration: Self-flashing without a cant strip, with mounting flange.
 - 2. Overall Height: 8 inches.
 - 3. Sound Curb: Curb with sound-absorbing insulation matrix.
 - 4. Pitch Mounting: Manufacture curb for roof slope.
 - 5. Metal Liner: Galvanized steel.
 - 6. Mounting Pedestal: Galvanized steel with removable access panel.
 - 7. Vented Curb: Unlined with louvered vents in vertical sides.

2.02 CENTRIFUGAL WALL VENTILATORS

- A. 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:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Acme Engineering & Mfg. Corp.
 - 2. Carnes Company HVAC.
 - 3. Greenheck.
 - 4. Loren Cook Company.
 - 5. Penn Ventilation.
- D. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- E. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.
- F. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.
- G. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust airstream.
- H. Accessories:
 - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
 - 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - 3. Wall Grille: Ring type for flush mounting.
 - 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.
 - 5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

2.03 CEILING-MOUNTING VENTILATORS

- A. 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Acme Engineering & Mfg. Corp.
 - 2. Carnes Company HVAC.
 - 3. Greenheck.
 - 4. Loren Cook Company.
 - 5. Penn Ventilation.

- D. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- E. Housing: Steel, lined with acoustical insulation.
- F. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- G. Grille: Aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- H. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- I. Accessories:
 - 1. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
 - 2. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
 - 3. Motion Sensor: Motion detector with adjustable shutoff timer.
 - 4. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
 - 5. Filter: Washable aluminum to fit between fan and grille.
 - 6. Isolation: Rubber-in-shear vibration isolators.
 - 7. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.04 IN-LINE CENTRIFUGAL FANS

- A. 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Acme Engineering & Mfg. Corp.
 - 2. Carnes Company HVAC.
 - 3. Greenheck.
 - 4. Loren Cook Company.
 - 5. Penn Ventilation.
- D. Description: In-line, direct-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- E. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- F. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

- G. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- H. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- I. Accessories:
 - 1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
 - 2. Companion Flanges: For inlet and outlet duct connections.
 - 3. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 - 4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.05 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Support units using elastomeric mounts having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- F. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- G. Install units with clearances for service and maintenance.
- H. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

- I. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- J. Install ducts adjacent to power ventilators to allow service and maintenance.
- K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.02 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 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 cleaning and adjusting are complete.
 - 4. 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.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 23 36 00

AIR TERMINAL UNITS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fan-powered air terminal units.
 - 2. Shutoff, single-duct air terminal units.

1.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
 - 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
- C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
- D. Field quality-control reports.
- E. Operation and maintenance data.

1.04 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.01 FAN-POWERED AIR TERMINAL UNITS

- A. Manufacturers:

1. Trane.
 2. Price.
 3. Nailor.
 4. Johnson Controls Inc.
 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud within a raised access floor.
- C. Casing: 22 gauge single wall.
1. Casing Lining: Adhesive attached, 1/2-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Cover liner with nonporous foil.
 - b. Cover liner with nonporous foil and perforated metal.
 2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
 5. Fan: Forward-curved centrifugal.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Motor:
1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 2. Type: Electronically commutated motor.
 3. Fan-Motor Assembly Isolation: Rubber isolators.
 4. Verify availability of enclosure types with manufacturer of specified equipment. Delete "Enclosure" Subparagraph below if information is included in schedule on Drawings.
 5. Enclosure: Open dripproof.
 6. Efficiency: Minimum 70% efficient over entire operating range.
 7. Motor Speed: Multispeed, constant torque.
 - a. Speed Control: Infinitely adjustable with electronic controls.
 8. Electrical Characteristics:
 - a. Provide electrical connections as specified in equipment schedule.
- E. Attenuator Section: 22 gauge sheet.
1. Lining: Adhesive attached, 1/2-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Cover liner with nonporous foil.
 - b. Cover liner with nonporous foil and perforated metal.
 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

- F. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
 - 1. Access door interlocked disconnect switch.
 - 2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 - 3. Nickel chrome 80/20 heating elements.
 - 4. Airflow switch for proof of airflow.
 - 5. Fan interlock contacts.
 - 6. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 - 7. Mercury contactors.
- G. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
 - 1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
 - 2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
 - 3. Disconnect Switch: Factory-mounted, fuse type.
- H. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- I. Electric Controls: 24-V damper actuator with wall-mounted electric thermostat and appropriate mounting hardware.
- J. Electronic Controls: Bidirectional damper operator and microprocessor-based controller with integral airflow transducer and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:
 - 1. Occupied and unoccupied operating mode.
 - 2. Remote reset of airflow or temperature set points.
 - 3. Adjusting and monitoring with portable terminal.
 - 4. Communication with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."

2.02 SINGLE DUCT VARIABLE VOLUME AIR TERMINAL UNITS

- A. Manufacturers:
 - 1. Trane.
 - 2. Price.
 - 3. Nailor.
 - 4. Johnson Controls Inc.
 - 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Variable air volume terminal units for connection to central air systems with electronic controls and electric heating coils.
- C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.

D. Basic Assembly:

1. Casings: Minimum 22 gage galvanized steel.
2. Lining: Minimum 1-inch thick neoprene or vinyl coated glass fiber insulation, 1.5 lb./cu ft density, meeting NFPA 90A requirements and UL 181 erosion requirements.
3. Plenum Air Inlets: Round stub connections and S slip and drive connections for duct attachment.
4. Plenum Air Outlets: S slip-and-drive connections.

E. Basic Unit:

1. Configuration: Air volume damper assembly inside unit casing. Locate control components inside protective metal shroud.
2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings; maximum damper leakage: 2 percent of design air flow at 1 inches rated inlet static pressure.
3. Mount damper operator to position damper normally open.

F. Electric Heating Coil:

1. Construction: UL listed, slip-in type, open coil design, integral control box factory wired and installed, with:
 - a. Primary and secondary over-temperature protection.
 - b. Minimum airflow switch.
 - c. Mercury contactors.

G. Automatic Damper Operator:

1. Electric Actuator: 24 volt.

2.03 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, reheat type and ARI certification seal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

3.03 CONNECTIONS

- A. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."
- B. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.04 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.05 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.06 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.

5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.07 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Diffusers.
 - 2. Registers
 - 3. Grilles.
 - 4. Door grilles.
 - 5. Louvers.
- B. Related Sections:
 - 1. Section 09 90 00 - Painting and Coating: Execution and product requirements for Painting of ductwork visible behind outlets and inlets specified by this section.
 - 2. Section 23 09 00 - Instrumentation and Control for HVAC: Operators for adjustable louvers.
 - 3. Section 23 09 23 - Direct-Digital Control System for HVAC: Operators for adjustable louvers.
 - 4. Section 23 33 00 - Air Duct Accessories: Volume dampers for inlets and outlets.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.07 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.08 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for air outlets and inlets.

1.09 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 - PRODUCTS

2.01 ROUND CEILING DIFFUSERS

- A. Manufacturers:
 - 1. Carnes Company.
 - 2. Hart & Cooley Inc.
 - 3. METALAIRE, Inc.
 - 4. Price Industries.
 - 5. Titus.
- B. Product Description: Type: Round, stamped or spun, multi-core diffuser to discharge air in 360 degree pattern, with sector baffles where indicated. Diffuser collar not more than 1 inch above ceiling. In plaster ceilings, furnish plaster ring and ceiling plaque.
- C. Fabrication: Steel with baked enamel off-white finish.

2.02 RECTANGULAR CEILING DIFFUSERS

- A. Manufacturers:
 - 1. Carnes Company.
 - 2. Hart & Cooley Inc.
 - 3. METALAIRE, Inc.
 - 4. Price Industries.
 - 5. Titus.

- B. Type: Square, stamped, multi-core diffuser to discharge air in four-way pattern with sector baffles where indicated.
- C. Frame: Inverted T-bar type. In plaster ceilings, furnish plaster frame and ceiling frame.
- D. Fabrication: Steel with baked enamel off-white finish.

2.03 PERFORATED FACE CEILING DIFFUSERS

- A. Manufacturers:
 - 1. Carnes Company.
 - 2. Hart & Cooley Inc.
 - 3. METALAIR, Inc.
 - 4. Price Industries.
 - 5. Titus.
- B. Type: Perforated face with fully adjustable pattern and removable face.
- C. Frame: Inverted T-bar type. In plaster ceilings, furnish plaster frame and ceiling frame.
- D. Fabrication: Steel with aluminum frame and baked enamel off-white finish.

2.04 CEILING SLOT DIFFUSERS

- A. Manufacturers:
 - 1. Carnes Company.
 - 2. Hart & Cooley Inc.
 - 3. METALAIR, Inc.
 - 4. Price Industries.
 - 5. Titus.
- B. Type: Continuous 3/4 inch wide slot, three slots wide, with adjustable vanes for left, right or vertical discharge..
- C. Fabrication: Aluminum extrusions with factory finish, color to be selected.
- D. Frame: 1-1/4 inch margin with c mounting and gasket end cap.
- E. Plenum: Integral, galvanized steel, insulated.

2.05 WALL SUPPLY REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Carnes Company.
 - 2. Hart & Cooley Inc.
 - 3. METALAIR, Inc.
 - 4. Price Industries.
 - 5. Titus.
- B. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.
- C. Frame: 1-1/4 inch margin with concealed mounting and gasket.
- D. Fabrication: Aluminum extrusions with factory off-white enamel finish.

- E. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face.

2.06 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Carnes Company.
 - 2. Hart & Cooley Inc.
 - 3. METALAIRE, Inc.
 - 4. Price Industries.
 - 5. Titus.
- B. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.
- C. Frame: 1-1/4 inch margin with concealed mounting.
- D. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory off-white enamel finish.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.
- F.

2.07 WALL GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Carnes Company.
 - 2. Hart & Cooley Inc.
 - 3. METALAIRE, Inc.
 - 4. Price Industries.
 - 5. Titus.
- B. Type: Fixed grilles of 1/2 x 1/2 x 1/2 inch louvers.
- C. Frame: Lay-in frame for suspended grid ceilings.
- D. Fabrication: Aluminum with factory off-white enamel finish.
- E. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face.

2.08 DOOR GRILLES

- A. Manufacturers:
 - 1. Carnes Company.
 - 2. Hart & Cooley Inc.
 - 3. METALAIRE, Inc.
 - 4. Price Industries.
 - 5. Titus.
- B. Type: V-shaped louvers of 20 gage thick steel, 1 inch deep on 1/2 inch centers.

- C. Frame: 20 gage steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

2.09 LOUVERS

- A. Manufacturers:
 - 1. Carnes Company.
 - 2. Greenheck Fan Corporation.
 - 3. Hart & Cooley Inc.
 - 4. METALAIRE, Inc.
 - 5. Ruskin Company.
 - 6. United Enertech
- B. Product Description: Stationary Drainable.
- C. Type: 6 inch deep with blades on 45 degree slope, heavy channel frame.
- D. Fabrication: 16 gage thick galvanized steel or 12 gage thick extruded aluminum, welded assembly, with factory anodized finish color to be selected.
- E. Mounting: Furnish with appropriate mounting flange for installation type.
- F. Bird Screen: Bird screen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.
- G. Insect Screen: Aluminum or steel mesh, set in aluminum frame.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify inlet and outlet locations.
- C. Verify ceiling and wall systems are ready for installation.

3.02 INSTALLATION

- A. Install diffusers to ductwork with airtight connection.
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00.
- C. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 90 00.
- D. Do not locate air registers, diffusers or grilles in floors of toilet or bathing rooms.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION

SECTION 23 41 00

PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pleated panel filters.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

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 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

B. Comply with NFPA 90A and NFPA 90B.

PART 2 - PRODUCTS

2.01 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.
 - c. Camfil Farr.

B. Filter Unit Class: UL 900, Class 2.

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: 28-point high wet-strength beverage board sealed or bonded to the media.
- E. Capacities and Characteristics:
1. Thickness or Depth: 2 inches.
 2. System Airflow: See AHU schedule on drawings.
 3. Maximum or Rated Face Velocity: 500 fpm.
 4. Efficiency: 90 percent on particles 20 micrometers and larger at 500 fpm.
 5. Initial Resistance: 0.3-inch wg at 500 fpm.
 6. Recommended Final Resistance: 1.0 inches wg.
 7. MERV Rating: 8 when tested according to ASHRAE 52.2.

2.02 HIGH EFFICIENCY, HIGH CAPACITY, PLEATED PANEL FILTERS

- A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.
- B. 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. AAF International.
 2. Airguard.
 3. Camfil Farr.
 4. Substitutions: Section 01 60 00 - Product Requirements.
- C. Filter Unit Class: UL 900, Class 2.
- D. 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.
- E. Filter-Media Frame: 28-point high wet-strength beverage board sealed or bonded to the media.
- F. Capacities and Characteristics:
1. Thickness or Depth: 2 inches.
 2. System Airflow: See AHU schedule on drawings.
 3. Maximum or Rated Face Velocity: 500 fpm.
 4. Efficiency: 90 percent on particles 20 micrometers and larger at 500 fpm.
 5. Initial Resistance: 0.4-inch wg at 500 fpm.
 6. Recommended Final Resistance: 1.0 inches wg.
 7. MERV Rating: 13 when tested according to ASHRAE 52.2.

PART 3 - EXECUTION

3.01 INSTALLATION

- 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.

3.02 CLEANING

- A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION

SECTION 23 81 09
PACKAGED ROOFTOP AIR CONDITIONING UNITS - LARGE CAPACITY

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Packaged rooftop air conditioning unit.
- B. Related Sections:
 - 1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Vibration isolators.
 - 2. Section 23 09 23 - Direct-Digital Control System for HVAC: Controls remote from unit.
 - 3. Section 23 33 00 - Air Duct Accessories: Flexible connections.
 - 4. Section 23 09 35 - Variable-Frequency Motor Drive: Variable frequency controllers.

1.02 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
 - 2. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 - 2. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. ASTM International:
 - 1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
- E. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA MG 1 - Motors and Generators.
- F. National Fire Protection Association:
 - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.03 DEFINITIONS

- A. Energy Efficiency Ratio (EER) - Ratio of net cooling capacity in Btuh to total rate of electric input in watts under designated operating conditions.
- B. Integrated Part-Load Value (IPLV): Single-number figure of merit based on part-load EER, COP, or kW/ton expressing part-load efficiency for air-conditioning and heat pump equipment on basis of weighted operation at various load capacities for the equipment.

1.04 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data indicating:
 - 1. Cooling and heating capacities.
 - 2. Dimensions.
 - 3. Weights.
 - 4. Rough-in connections and connection requirements.
 - 5. Duct connections.
 - 6. Electrical requirements with electrical characteristics and connection requirements.
 - 7. Controls.
 - 8. Accessories.
- C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- D. Manufacturer's Field Reports: Manufacturer's Field Reports: Submit start-up report for each unit.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of controls installed remotely from units.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.06 QUALITY ASSURANCE

- A. Cooling Capacity: Rate in accordance with ARI 340/360.
- B. Sound Rating: Measure in accordance with ARI 270.
- C. Insulation and adhesives: Meet requirements of NFPA 90A.
- D. Performance Requirements: Conform to minimum EER prescribed by ASHRAE 90.1 when tested in accordance with ARI 340/360.
- E. Outside Air Damper Leakage: Test in accordance with AMCA 500.

1.07 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept units on site. Inspect for damage.
- C. Protect units from damage by storing off roof until roof mounting curbs are in place.

1.09 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate installation of roof curbs with roof structure, roof deck and roof membrane installation.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five year manufacturer's warranty for compressors.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish one set of filters for each unit.

PART 2 - PRODUCTS

2.01 PACKAGED ROOFTOP AIR CONDITIONING UNIT

- A. Manufacturers:
 - 1. Carrier.
 - 2. Daikin.
 - 3. Johnson Controls.
 - 4. Trane.
 - 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Self-contained, packaged, factory assembled and wired unit, consisting of cabinet, casing, and frame; supply fan section; variable frequency drive; cooling coil section; compressor; condensing section; refrigerant circuit; filter section; final filter section; outdoor and return air section; exhaust and relief air section; electrical; controls; and accessories.
- C. Configuration:
 - 1. Air delivery: Downflow.
 - 2. Draw through.
- D. Identification: Furnish units with decals and tags to indicate caution areas and aid in unit service. Fix unit nameplates to main control panel door. Attach electrical wiring diagrams to control panels.
- E. Cabinet, Casing, and Frame:
 - 1. Designed for outdoor installation with weatherproof construction.
 - 2. Frame and unit base: Constructed of galvanized steel. Base overhangs roof curb for water runoff and constructed with formed recess seating on roof curb gasket for positive weather tight seal. Furnish lifting brackets on unit base with lifting holes to accept cable or chain hooks.
 - 3. Finish: Exterior surfaces finished with baked on enamel paint exceeding 500 hour salt spray test in accordance with ASTM B117.
 - 4. Insulation: Factory applied to exposed vertical and horizontal panels. 2 inch thick foam filled panels or aluminum foil faced glass fiber with edges protected from erosion.

5. Access doors: Furnish access doors or removable access panels.
- F. Supply Fan Section:
1. Fan: Forward curved centrifugal type, statically and dynamically balanced, resiliently mounted.
 2. Fan Drive: V-Belt type, Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Furnish solid shaft construction. Select Variable and adjustable pitch motor sheave to obtain required rpm with sheaves set at mid-position as recommended by manufacturer.
 - a. Drive Rating: Minimum 1.5 times nameplate rating of motor.
 - b. Fan Sheave: Fixed.
 - c. Motor Sheave: Fixed.
 3. Fan motor: Three phase, NEMA MG1, Design B, continuously rated at 40 degrees C, premium open drip-proof efficiency NEMA T frame, with permanently lubricated bearings and integral overload protection.
- G. Supply Fan Modulation:
1. Variable Frequency Drive: Refer to Section 25 09 35.
 2. Controlled from duct static pressure by unit mounted controller. Static pressure sensed by duct mounted sensor.
 3. Furnish field adjustable duct high limit safety control to protect duct work from excessive duct pressure.
- H. Cooling Coil Section:
1. Coil: Constructed of seamless copper tubes mechanically expanded into aluminum fins. Furnish with intertwined circuits with multiple rows. Factory leak tested under water.
 2. Drain Pan: Stainless steel, positively sloped extending beyond leaving side of coil and under cooling coil connections. Connect to drain connection extending through unit base. Furnish units with stacked cooling coils with secondary drain pan connected to primary drain pan.
 3. Location: Upstream of fan section.
- I. Compressors:
1. Hermetic type with reversible, positive displacement oil pump, suction and discharge line service valves, crankcase heater, high efficiency blocked suction unloading, and internal motor overload protection.
 2. Furnish each compressor with independent refrigeration circuit.
 3. Furnish external vibration isolators.
 4. Furnish vibration eliminators on suction and discharge piping.
 5. Furnish short cycle protection.
- J. Condensing Section:
1. Condenser coils: Constructed of copper tubing mechanically bonded to aluminum fins. Factory leak tested under water.
 2. Condenser fans: Direct drive, propeller type, vertical air discharge. Fan blades constructed of steel. Condenser fan motors high efficiency totally enclosed type with internal motor overload protection, three-phase non-reversing type with permanently lubricated ball bearing and integral rain shield.
 3. Furnish factory installed coil guard.
- K. Refrigeration circuit:
1. Dehydrate and factory charge each circuit with oil and refrigerant.
 2. Furnish the following for each circuit:
 - a. Thermal expansion device.
 - b. Filter-drier.
 - c. Replaceable core filter drier.

- d. Suction, discharge, and liquid line service valves with gauge ports.
 - e. Sight glass.
 - f. High and low pressure safety controls.
 - g. Liquid line solenoid valve.
 - h. Sub-cooler circuit to provide 15 degrees of liquid sub-cooling.
 - 3. Capacity control:
 - a. By cycling compressors.
 - b. Hot gas bypass: Factory installed on each refrigerant circuit including hot gas bypass valve, solenoid valve and hot gas bypass piping.
 - 4. Furnish control to provide low ambient cooling to 0 degrees F.
- L. Filter Section:
- 1. Location: Upstream of fan section.
 - 2. Furnish section with integral galvanized steel filter racks contained within unit.
 - 3. Disposable filters: Refer to Section 23 41 00.
- M. Final Filter Section:
- 1. Location: Downstream of supply fan and coils.
 - 2. Cartridge Filters: Refer to Section 23 41 00.
- N. Outdoor and Return Air Section:
- 1. Outside Air Damper Leakage: Maximum 3.0 cfm per square foot at 1.0 inches wg pressure differential.
 - 2. Actuators: Furnish factory installed electric damper actuators for outside air, return air, and exhaust air dampers.
 - 3. Economizer: Provide economizer components and controls in accordance with ICC IECC. Furnish fully integrated factory installed fully modulating from 0 to 100 percent outside air with minimum position setting. Operation through microprocessor based primary temperature controls automatically modulate dampers to maintain space temperature conditions.
 - a. Furnish economizer with dry bulb control.
 - b. Furnish spring return motor for outside air damper closure during unit shutdown or power interruption.
- O. Exhaust and Relief Air Section:
- 1. Modulating exhaust fans: Forward curved centrifugal type, belt drive, sized for 100 percent air flow, statically and dynamically balanced, high efficiency motor. Motor permanently lubricated with built-in thermal overload protection. Furnish barometric dampers at fan outlet to prevent backdraft. Fans operated with volume control device based on field adjustable interior space pressure setpoint.
- P. Electrical:
- 1. Furnish with factory wired weatherproof control panel with deadfront cover.
 - 2. Furnish with single point power terminal block for main power connection.
 - 3. Furnish terminal board for low voltage control wiring.
 - 4. Furnish branch circuit fusing, 115 volt control circuit transformer and fuse, system switches, high temperature sensor, and 115 volt ground fault receptacle with separate electrical connection.
 - 5. Phase Failure and Under Voltage Protection: Furnish for three-phase motors to prevent damage from single phasing, phase reversal, and low voltage conditions.
 - a. Ground Fault Protection: Furnish on three-phase motors to protect against arcing ground faults.
- Q. Controls: Furnish interface to Direct Digital Control System specified in Section 23 09 23.
- R. Controls: Microprocessor based controls, factory mounted with the following features:

1. Variable Air Volume Controls: To operate VAV rooftop from supply air temperature including supply air sensor, and variable frequency drive. Microprocessor coordinates economizer control and stages of cooling with supply air temperature reset capability based upon outdoor air temperature.
2. Furnish the following setpoints and diagnostic functions accessible in unit control panel and BACnet interface:
 - a. Unit operating mode.
 - b. Unit failure status.
 - c. Supply fan start-stop.
 - d. Supply fan status.
 - e. Supply fan variable frequency drive percent.
 - f. Exhaust fan start-stop.
 - g. Exhaust fan status.
 - h. Exhaust fan variable frequency drive percent.
 - i. Supply air temperature.
 - j. Supply air temperature high-low limit with alarm.
 - k. Return air temperature.
 - l. Return air temperature high-low limit with alarm.
 - m. Mixed air temperature.
 - n. Mixed air temperature high-low limit with alarm.
 - o. Duct static pressure.
 - p. Duct static pressure high-low limit with alarm.
 - q. Cooling control.
 - r. Cooling status - all stages.
 - s. Number of stages activated.
 - t. Damper control.
 - u. Economizer status.
 - v. Requested minimum position.
 - w. Damper positions.
 - x. Space temperature.
 - y. Space temperature high-low limit with alarm.
 - z. Filter status.
 - aa. Smoke detector status.
 - bb. Outside air temperature.
 - cc. Outside relative humidity.

2.02 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Disconnect Switch: Factory mounted. Non-fused type. Internal to unit or accessible through door.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.02 INSTALLATION

- A. Roof Curb:
 1. Assemble roof curb.

2. Install roof curb level.
 3. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
 4. Install gasket material between unit base and roof curb.
- B. Connect units to supply and return ductwork with flexible connections. Refer to Section 23 33 00.
- C. Install condensate piping with trap and route from drain pan to nearest roof drain. Refer to Section 23 21 13.
- D. Install components furnished loose for field mounting.
- E. Install electrical devices furnished loose for field mounting.
- F. Install control wiring between unit and field installed accessories.
- G. Remove from roof and dispose off-site panels removed from units during installation of economizer and dampers.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish services of factory trained representative to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.04 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Vacuum clean coils and inside of unit cabinet.
- C. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.05 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate unit operation and maintenance.

END OF SECTION

SECTION 23 82 00
UNIT HEATERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Electric unit heaters.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- C. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access to valves.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept units on site in factory packing. Inspect for damage. Store under roof.
- C. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.5 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 ELECTRIC UNIT HEATERS

- A. 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:
 - 1. Berko Electric Heating.
 - 2. Markel Products.

3. Indeeco.
 - B. Assembly: UL listed and labeled assembly with terminal box and cover, and built-in controls.
 - C. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material. Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings.
 - D. Cabinet: 0.0478-inch thick steel with easily removed front panel with integral air outlet and inlet grilles.
 - E. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
 - F. Fan: Direct-drive propeller type, statically and dynamically balanced, with fan guard.
 - G. Motor: Permanently lubricated, sleeve bearings for horizontal models; ball bearings for vertical models.
 - H. Control: Separate fan speed switch and thermostat heat selector switch, factory wired, with switches built-in behind cover. Furnish thermal overload.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify wall construction is ready for installation.
- C. Verify concealed blocking and supports are in place and connections are correctly located.

3.2 INSTALLATION

- A. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- B. Install coils level.
- C. Make connections to coils with unions and flanges.
- D. Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- E. Hydronic Units: Install with shut-off valve on supply piping and lockshield balancing valve on return piping.
- F. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals.

3.3 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

- B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- C. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 260500
COMMON RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 INSPECTION FEES AND PERMITS

- A. Obtain and pay for all necessary permits and inspection fees required for electrical installation.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's data on equipment and materials, and shop drawings, only as listed below. Clearly indicate proposed substitutions and deviations from drawings and specifications. Approval of product data and shop drawings is not to be interpreted as permitting departure from the contract documents. SUBMIT DATA ELECTRONICALLY.

262726 - Wiring Devices

262500- Busway

262413/262416/262816 - Panelboards and Switchgear and Overcurrent Protection devices

260913 – Electrical Power Monitoring and Control

265100/260926 -Lighting fixtures and controls

264313 - SPD Devices

283111 – Digital Addressable Fire Alarm System

- B. Coordination Drawings: Prepare coordination drawings (scale 1/4" = 1'-0") showing all switchgear, power panels, lighting contactors, and panelboards in each electrical room. Indicate all ductwork, HVAC equipment, plumbing fixtures, and water piping in the room. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.

- C. Operating and Maintenance Manuals: Provide three sets of the following data. Arrange each set of data in an orderly way, and bind each set in a separate 3-ring, hard-cover binder:

Operating and maintenance instructions.

Spare parts list.

Copies of approved submittal data.

Record Drawings (As-builts)

1.04 QUALITY ASSURANCE

- A. 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.

- B. Comply with applicable local, state and national codes. Comply with applicable requirements of recognized industry associations which promulgate standards for the various trades.
- C. Employ only qualified journeymen for this work. Employ a competent qualified mechanic to supervise the work.

1.05 COORDINATION

- A. Carefully examine specifications and drawings to be thoroughly familiar with items which require electrical connections and coordination.
- B. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
- C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- D. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components and telecommunications services.
 - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- E. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

1.06 TEMPORARY POWER

- A. Provide a temporary electrical power distribution system of adequate size to properly serve the project.

1.07 DELIVERY AND STORAGE

- A. Deliver items in manufacturer's original unopened packaging. Use care in loading, transporting, unloading, and storage to keep items from being damaged.
- B. Store items in a clean dry place and protect from damage.
- C. All damaged painted surfaces of equipment to be touched up to match original paint.

1.08 RECORD DRAWINGS

- A. Keep a set of prints at the job site exclusively for recording deviations from the drawings which are necessary because of job conditions.
- B. Record locations and depths of buried and concealed conduits.
- C. Mark deviations in colored pencils so that work of various systems can be easily identified.
- D. Submit completed "record drawings" to Owner's Representative for distribution.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. All materials and equipment shall be new and have UL listing when such listings are available.
- B. Provide named manufactured products unless an equal product has been approved.

2.02 ELECTRICAL IDENTIFICATION

- A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with type of utility identified on tape.
- C. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness. Attached with self-tapping, stainless-steel screws. Engraved in white letters on black background for normal power; white letters on red background for emergency and optional standby power.

PART 3 EXECUTION

3.01 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

3.02 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Selection of Supports: Comply with manufacturer's written instructions.
- D. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.03 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, using industry-proved attachment methods.

3.04 IDENTIFICATION MATERIALS AND DEVICES

- A. Properly identify all starters, contactors, safety switches and panels with permanently attached plates.
- B. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- D. Color-code system secondary service, feeder, and branch-circuit conductors throughout the electrical system as follows:

VOLTAGE	120/208 3-PH, 4-W	277/480 3-PH, 4-W
PHASE A	BLACK	BROWN
PHASE B	RED	ORANGE
PHASE C	BLUE	YELLOW
NEUTRAL (GROUNDED) CONDUCTOR	WHITE	GREY
GROUND CONDUCTOR	GREEN	GREEN

3.05 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.06 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.07 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3.

3.08 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.09 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

3.010 TESTS

- A. On completion of work, the installation is to be entirely free of ground faults, short circuits, and open circuits. Perform a thorough operational test of all systems. Balance circuits so feeders to panels are not more than 10% out of balance between phases with all available load energized and operating. Furnish all labor, materials and instruments for above tests.

3.011 OWNER FURNISHED EQUIPMENT

- A. Provide wiring for Owner furnished equipment when required.
- B. Provide controls, receptacles, disconnect switches, conduit, wiring, and connections as required. Verify all requirements before rough-in.
- C. All equipment to be left in good working order.

END OF SECTION

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.03 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled, as defined in NFPA 70, Article 100.
- B. Comply with NFPA 70.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wires and cables according to NEMA WC 26.

1.05 COORDINATION

- A. Coordinate layout and installation of cables with other installations.
- B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Architect.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. 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:
 - 1. Wires and Cables:
 - a. American Insulated Wire Corp.; Leviton Manufacturing Co.
 - b. BICC Brand-Rex Company.
 - c. Carol Cable Co., Inc.
 - d. Senator Wire & Cable Company.
 - e. Southwire Company.
 - 2. Connectors for Wires and Cables:
 - a. AMP Incorporated.
 - b. General Signal; O-Z/Gedney Unit.
 - c. Monogram Co.; AFC.
 - d. Square D Co.; Anderson.
 - e. 3M Company; Electrical Products Division.

2.02 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
- B. Rubber Insulation Material: Comply with NEMA WC 3.
- C. Thermoplastic Insulation Material: Comply with NEMA WC 5.
- D. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 7.
- E. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.
- F. Conductor Material: Copper.
- G. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.
- H. Jacket Color: All conductors of ALL sizes shall be color-coded per section 16010-3.4(D). The entire jacket for each conductor shall be color coded for each phase, neutral, and ground. Tape bands on each end of the conductor is not acceptable.

2.03 CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 WIRE AND INSULATION APPLICATIONS

- A. Service Entrance: Type RHW or THWN, in raceway.
- B. Feeders: Type THHN/THWN, in raceway.
- C. Branch Circuits: Type THHN/THWN, in raceway.
- D. Fire Alarm Circuits: Power-limited, fire-protective, signaling circuit cable.

3.03 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
- B. Pull Conductors: 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 16 Section 16010.
- F. Seal around cables penetrating fire-rated elements according to Division 7 Section "Firestopping."

- G. Identify wires and cables according to Division 16 Section "Basic Electrical Materials and Methods."

3.04 CONNECTIONS

- A. Conductor Splices: Keep to minimum.
- B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- C. Use splice and tap connectors compatible with conductor material.
- D. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.
- E. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- F. 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 and UL 486B.

3.05 FIELD QUALITY CONTROL

- A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
- B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Ground the entire system of raceways and equipment in accordance with Article No. 250 of the National Electrical Code (N.E.C.) and all local ordinances and regulations of local authority having jurisdiction.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide electrical grounding systems as indicated, including conductors, connectors, bonding jumper braid, and all accessories needed for a complete installation. Where materials or components are not indicated, provide products complying with the N.E.C. and established industry standards.

PART 3 EXECUTION

3.01 GENERAL

- A. Effectively bond all grounding conductors to grounding electrodes, equipment enclosures and ground busses.

3.02 GROUNDING ELECTRODE

- A. Neutral bus in main service switchboard or panelboard shall be bonded to street side of first flange or coupling of incoming main water line serving project with heavy-duty ground clamp in accordance with Article 250 of N.E.C. An additional ground wire of same size shall be run to a tri-pod grounding rod system driven in ground outside foundation of building. This system shall consist of three 3/4" x 10' copperweld ground rods driven in ground in an equilateral triangular configuration with a minimum of 15' spacing between each. Connection of each ground rod to one another shall be made using a conductor or same size as being run for main service ground. Building steel shall be connected to ground bus on main service with a conductor the same as required on the service. This ground will be in addition to the previously specified grounds.

3.03 TELEPHONE SYSTEM GROUNDING

- A. Provide a #4 AWG copper grounding conductor from the service ground (at the service entrance panelboard or switchgear) to a junction box at the telephone terminal board.

3.04 INSTALLATION

- A. General: Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.
- B. Locate all grounding attachments away from areas subject to physical damage. Provide protective covering as required.
- C. Clean all non-conductive surfaces on equipment to be grounded, to assure good electrical continuity.
- D. Feeder circuits shall have a separate green grounding conductor in conduit sized in accordance with Article 250 of the N.E.C.

- E. Branch circuits shall have a separate green grounding conductor installed in same conduit as phase and neutral conductor from panel ground bus to device. The grounding conductor shall be sized in accordance with Article 250 of the N.E.C.
- F. Grounding Rods: Locate a minimum of 1-rod length from each other and at least the same distance from any other grounding electrode.
 - 1. Drive until tops are 2 inches (50 mm) below finished floor or final grade, except as otherwise indicated.
 - 2. Interconnect with grounding-electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make these connections without damaging copper coating or exposing steel.
- G. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- H. Underground Grounding Conductors: Use bare copper wire. Bury at least 24 inches (600 mm) below grade.
- I. Metal Water Service Pipe: Provide insulated copper grounding conductors, sized as indicated, 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 by grounding-clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Do not install a grounding jumper across dielectric fittings. Bond grounding-conductor conduit to conductor at each end.
- J. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding-clamp connectors.
- K. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- L. Electrical Room Grounding Bus: Space 1 inch (25 mm) from wall and support from wall 6 inches (150 mm) above finished floor, except as otherwise indicated.

3.05 CONNECTIONS

- A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

- C. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.
- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- G. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.06 TESTING

- A. Ground on main service shall be tested to obtain no greater than 10 ohms using test equipment similar to a "Biddle" test. Test data to be submitted to Architect for approval and such approved test data to become a part of the final brochure.
- B. If the resistance to ground is over 10 ohms, take appropriate action to reduce resistance to 10 ohms or less by driving additional ground rods and/or by chemically treating the soil encircling the ground rod.

END OF SECTION

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. GRC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
- B. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Equipment supports.

1.07 QUALITY ASSURANCE

- A. Comply with NFPA 70.

1.08 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical 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 malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. 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 in which used. a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. Empire Tool and Manufacturing Co., Inc.
 - c. Hilti Inc.
 - d. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - e. MKT Fastening, LLC.
2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 5. Toggle Bolts: All-steel springhead type.
 6. Hanger Rods: Threaded steel.

2.02 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 Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.04 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacing is less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. 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.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in 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 shall be weight of supported components plus 200 lb (90 kg).
- 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 Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. 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.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "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.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05mm).
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533

RACEWAYS AND BOXES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Requirements of the following Division 26 Sections apply to this Section:
 - 1. "Electrical Requirements."
 - 2. "Basic Material and Methods"

1.02 SUMMARY

- A. Drawings are diagrammatic. All bends, boxes, fittings, couplings are not necessarily shown. Supply as necessary to comply with the National Electric Code.
- B. This Section includes raceways for electrical wiring. Types of raceways, boxes and fittings in this section include the following:
 - 1. Electrical metallic tubing (EMT).
 - 2. Flexible metal conduit.
 - 3. Intermediate metal conduit (IMC).
 - 4. Liquid-tight flexible conduit.
 - 5. Rigid metallic conduit (RMC).
 - 6. Surface raceways.
 - 7. Rigid non-metallic conduit.
 - 8. Electrical non-metallic tubing (ENT)
 - 9. Wireway.
 - 10. Outlet boxes.
 - 11. Junction boxes.
 - 12. Pull boxes.
 - 13. Bushings.
 - 14. Locknuts.
 - 15. Knockout closures.
- C. Related Sections: The following section contains requirements that relate to this section:
 - 1. Division 26 Section "Raceway and Boxes" for conduit connectors, fittings, and couplings.
 - 2. Division 7 Section "Firestopping" for conduit penetrations through rated walls and slabs.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of contract and Division 1 Specification Section.
- B. Product Data for the following products:

1. Raceways and fittings.
 2. Wireways and fittings.
 3. Boxes and fittings.
- C. Installation Instructions: Manufacturer's written installation instructions for wireway, surface raceway, and nonmetallic raceway products.

1.04 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- B. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
- C. UL Compliance and Labeling: Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL.
- D. Manufacturers: Firms regularly engaged in manufacture of electrical boxes and fittings, of types, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than five years.
- E. Installer's Qualifications: Firms with at least five years of successful installation experience on projects utilizing electrical boxes and fittings similar to those required for this project.
- F. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.
- G. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL-listed and labeled.
- H. NEMA Compliance: Comply with applicable requirements of NEMA Stds/Pub No.'s OS1, OS2 and PUB 250 pertaining to outlet and device boxes, covers and box supports.
- I. Federal Specification Compliance: Comply with applicable requirements of FS W-C 586, "Electrical Cast Metal Conduit Outlet Boxes, Bodies, and Entrance Caps."

PART 2 PRODUCTS

2.01 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1
- B. Intermediate Steel Conduit: UL 1242.
- C. Electrical Metallic Tubing and Fittings: ANSI C80.3.
- D. Flexible Metal Conduit: UL 1, zinc-coated steel.
- E. Liquid-tight Flexible Metal Conduit and Fittings: UL 360.

2.02 NONMETALLIC CONDUIT AND DUCTS

- A. Rigid Nonmetallic Conduit (RNC): NEMA TC 2 and UL 651, Schedule 40 or 80 PVC.
- B. PVC Conduit and Tubing Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
- C. Conduit, Tubing and Duct Accessories: Types, sizes and materials complying with manufacturer's published product information. Mate and match accessories with raceway.
- D. Electrical non-metallic tubing (ENT): NEMA TC13 and UL1653.

2.03 CONDUIT BODIES AND FITTINGS

- A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching gasket covers secured with corrosion-resistant screws.
- B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways.
- C. EMT Conduit Bodies 1 Inch and Smaller: Use bodies with steel set screw connectors and couplings for interior applications and steel compression gland connectors and couplings for exterior applications.
- D. EMT Conduit Bodies 1 Inch and Larger: Use bodies with steel set screw connectors and couplings for interior applications and steel compression gland connectors and couplings for exterior applications.
- E. Nonmetallic Conduit and Tubing: Use nonmetallic conduit bodies conforming to UL514B.
- F. Liquid-Tight Flexible Conduit Fittings: With threaded grounding cone, a steel, nylon or equal plastic compression ring, and a gland for tightening. Either steel or malleable iron only with insulated throats and male thread and locknut or male bushing with or without O-ring seal. Each connector shall provide a low resistance ground connection between the flexible conduit and the outlet box, conduit or other equipment to which it is connected.
- G. Bushings: Insulated type, designed to prevent abrasion of wires without impairing the continuity of the conduit grounding system, for rigid steel conduit, IMC and EMT, larger than $\frac{3}{4}$ " size.
- H. Expansion Fittings: Each conduit that is buried in or secured to the buildings construction on opposite sides of a building expansion joint and each long run of exposed conduit that may be subject to excessive stresses shall be provided with an expansion fitting. Expansion fittings for rigid steel conduit shall be hot-dipped galvanized malleable iron with factory installed packing and a grounding ring. Expansion fittings for rigid non-metallic conduit shall be of the short type in runs 25' or less, and the long type in runs 26' to 80'. The long type shall be a two piece barrel and piston joint, providing 6" of the total movement range in $\frac{3}{4}$ " through 6" conduit sizes. The short type shall be a one piece, coupling with O-ring, providing 2" of total movement range in $\frac{3}{4}$ " to 2" conduit sizes.

- I. Seal Off Fittings: Threaded, zinc or cadmium coated, cast or malleable iron type for steel conduits. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

2.04 WIREWAYS

- A. General: Electrical wireways shall be of types, sizes, and number of channels as indicated. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for complete system. Where features are not indicated, select to fulfill wiring requirements and comply with applicable provisions of NEC.
- B. Wireway covers shall be hinged type.

2.05 SURFACE RACEWAYS

- A. General: Sizes and channels as indicated on drawings. Provide fittings that match and mate with raceway. Provide internal barriers for areas with power and communications sections.
- B. Surface Metal Raceway: Construct of two piece galvanized steel with snap-on covers, with 9/32-inch mounting screw knockouts in base approximately 8 inches o.c. Finish with manufacturer's standard prime coating suitable for painting. Provide raceways of types suitable for each application required. Sizes 1-3/4" H x 4-3/4" W.
- C. Accessories:
 - 1. Couplings for joining raceway sections.
 - 2. Wire clips for conductors.
 - 3. Blank end fittings.
 - 4. Circuit breaker housings for single pole breakers.
 - 5. Device brackets for single or two gang devices.
 - 6. Combination receptacle and telephone outlet covers.
 - 7. Outlet boxes with hubs for conduit connectors.

2.06 FABRICATED MATERIALS – BOXES

- A. Outlet Boxes: Provide galvanized flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes (minimum 4 inch square, 1 ½ inch deep), including box depths as required, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.
 - 1. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.
- B. Device Boxes: Provide galvanized coated flat rolled sheet-steel non-gangable device boxes, of shapes, cubic inch capacities, and sizes (minimum 4 inch square, 1 ½ inches deep), including box depths as indicated, suitable for installation at respective

locations. Construct device boxes for flush mounting with mounting holes, and with conduit-size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide conduit connectors and corrosion-resistant screws for equipment type grounding.

1. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster ears, and plasterboard expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.
- C. Raintight Outlet Boxes: Provide corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring-hinged watertight caps suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners.
- D. Junction and Pull Boxes: Provide galvanized code-gauge sheet steel junction and pull boxes, with screw on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws, and washers. Pull boxes installed in finished spaces must be flush mounted cabinets provided with trim, hinged door and flush latch and lock to match flush mounted panelboard trim.
- E. Exterior junction or pull boxes, flush with grade:
1. Junction or pull box to be mounted flush with grade shall be polymer composite raintight with screw cover lids. Box dimensions shall be 30"W x 48"L x 36"D. Covers shall be polymer composite suitable for pedestrian traffic secured to box with stainless steel screws. Box to be furnished with continuous neoprene gasket to seal cover. Conduit entry shall be on side of box with bell ends.
- F. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

PART 3 EXECUTION

3.01 WIRING METHOD

- A. Outdoors: Use the following wiring methods:
1. Exposed: Intermediate metal conduit, rigid steel conduit.
 2. Concealed: Intermediate metal conduit, rigid steel conduit.
 3. Underground, Single Run: Rigid non-metallic conduit. PVC coated GRC 90° elbows.
 4. Underground, Grouped: Rigid non-metallic conduit. PVC coated GRC 90° elbows.
 5. Connection to Vibrating Equipment including transformers, pneumatic or electrical solenoid, and motor-operated equipment: Liquid-tight flexible metal conduit.
- B. Indoors: Use the following wiring methods:

- 1 Exposed (below 10 ft. to floor): Intermediate metal conduit, rigid steel conduit.
- 2 Exposed (above 10ft. or in electrical room): Electrical metallic tubing.
- 3 Concealed: Electrical metallic tubing.
- 4 Connection to Vibrating Equipment including transformers, pneumatic or electrical solenoid, and motor-operated equipment: Flexible metal conduit.
- 5 Connection to Vibrating Equipment in Moist/Humid or Corrosive Atmosphere including pneumatic or electric solenoid, and motor-operated equipment: Liquid-tight flexible metal conduit.
- 6 Within concrete slabs: electrical non-metallic tubing, PVC coated MC cable, or rigid non-metallic conduit. PVC coated MC cable is not allowed for homeruns. Homeruns shall be in conduit. Maximum sizes and locations as approved by the Structural Engineer.
- 7 Raceway mounted to underside of metal-corrugated sheet roof decking shall be Rigid Metal Conduit or intermediate Metal Conduit.

3.02 INSTALLATION OF RACEWAYS

- A. General: Install electrical raceways in accordance with manufacturers' written installation instructions, applicable requirements of NEC, and as follows.
- B. Conceal conduit and EMT, unless indicated otherwise, within finished wall, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.
- C. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.
- D. Complete installation of electrical raceways before starting installation of conductors within raceways.
- E. Provide supports for raceways as specified elsewhere in Division 26 and in accordance with NEC and local authority's seismic requirements.
- F. Prevent foreign matter from entering raceways by using temporary closure protection.
- G. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab. All elbow penetration through the slab shall be PVC coated rigid metallic conduit Ells.
- H. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
- I. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.
- J. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.
- K. Raceways embedded in slabs shall only be permitted with the strict written approval of the Structural Engineer and Architect. For bidding purpose, conduit shall not be permitted in slab.

- L. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. All exposed conduit runs shall be approved by the Architect prior to installing.
- M. All exposed conduits in public areas shall be painted to match surrounding walls. Verify exact color with the Architect. Painting specified herein shall be provided by others.
- N. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases, provide field bends for parallel raceways. All exposed conduit routing shall be approved by the Architect prior to installing.
- O. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Use expansion fittings at building expansion joints.
- P. Tighten set screws of threadless fittings with suitable tool.
- Q. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside of the box. All conduit connections to junction boxes shall have insulated bushings.
- R. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
- S. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave no less than 12 inches of slack at each end of the pull wire.
- T. Telephone and Signal System Raceways: In addition to the above requirements, raceways 2-inches and smaller, shall have a maximum length of 150 feet with a maximum of two 90° bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.
- U. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, 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 raceway sealing fittings at the following points and elsewhere as indicated:
 - 1. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces, air-conditioned spaces and walk-in coolers.
 - 2. Where required by the NEC.

- V. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded flush plugs flush with floor.
- W. Flexible connection: Use length (maximum of 6 ft.) of flexible conduit for recessed and semi-recessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible conduit in wet locations. Install separate equipment grounding conductor across flexible connections.
- X. Install nonferrous conduit or tubing for circuits operating above 60 Hz.
- Y. PVC externally coated rigid steel conduit: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduit.
- Z. All underground conduits shall be installed a minimum of 48 inches below finish grade for 30 inches for 480 volt feeders. All other conduits shall be installed in accordance with the NEC and coordinated depth with other trades.
- AA. Grounding: Install a separate green equipment grounding conductor in all raceways from the panelboard/junction box supplying the raceway to the receptacle or equipment ground terminals. Conduits will not be permitted as a ground conductor.
- BB. Emergency feeder raceways that are not concealed in the electrical room or in sprinkled spaces shall be wrapped in a 1-hour protected fire wrap (MFR: 3M interam wrap or approved equal).

3.03 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

- A. General: Install electrical boxes and fittings in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Provide raintight "in use" metal outlet boxes for interior and exterior locations exposed to weather or moisture.
- D. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.
- F. Installing boxes back-to-back in walls shall not be permitted. Provide no less than 12 inches (150 mm) of separation.
- G. Position recessed outlet boxes accurately to allow for surface finish thickness.
- H. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surfaces.

- I. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embedded electrical boxes in concrete or masonry.
- J. Provide electrical connections for installed boxes.
- K. Exterior junction or pull boxes shall be mounted flush with grade, unless noted otherwise or indicated to be above ground on the drawings. Boxes shall be surrounded on all sides with 6 inches minimum of concrete. Top of concrete shall flush with grade. Seal all conduit entries into box with duct seal to prevent entrance of moisture, after conductors are installed.
- L. Tap and splices, where permitted by these specifications within exterior junction boxes, shall be performed with an encapsulating watertight splice or tap kit which insulates and moisture seals the connection. Kit shall consist of the appropriate size and type mold, encapsulating resin and end sealing tape.
- M. Subsequent to installation of boxes, protect boxes from construction debris and damage.

3.04 GROUNDING

- A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

3.05 ADJUSTING AND CLEANING

- A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.

END OF SECTION

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification nameplates.
 - 7. Miscellaneous identification products.

1.03 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.04 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.05 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.02 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 in. (25 mm to 50 mm) wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.03 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape:
 - 1. Not less than 3 in. (75 mm) wide by 5 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.

2.04 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

- C. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396 in. (1.005 mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4 in. (6.4 mm) grommets in corners for mounting. Nominal size, 10 by 14 in. (254 mm by 355.6 mm).
- D. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 IN. (900 MM)."

2.05 EQUIPMENT IDENTIFICATION NAMEPLATES

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background.
- B. Lettering: Approximately 1/2 in. (13 mm) high for floor mounted equipment and 3/16 in. (4.76 mm) high for wall mounted equipment. Wording shall identify function of device to which nameplates is attached or identify equipment served by device.

2.06 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties:
 - 1. Minimum Width: 3/16 in. (4.76 mm).
 - 2. Tensile Strength: 50 lb (22.67 kg), minimum.
 - 3. Temperature Range: Minus 40 to plus 185°F (4°C to 85°C).
 - 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.
- C. 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

3.01 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables, 600-Volt or Less, for Service, Feeder, and Branch Circuits More Than 50 A: Identify with orange self-adhesive vinyl label.
- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, snap-around, color-coding bands:
 - 1. Fire Alarm System: Red.
 - 2. Fire-Suppression Supervisory and Control System: Red and yellow.
 - 3. Security System: Blue and yellow.
 - 4. Telecommunication System: Green and yellow.

5. Control Wiring: Green and red.
- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
- D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections:
 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access:
 1. 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.
 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- H. Instruction Signs:
 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
 2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8 in. (9.52 mm) high letters for emergency instructions at equipment used for power transfer.
- I. Equipment Identification Nameplates: On each unit of equipment, install unique designation nameplate that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply nameplates to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control,

communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification:

1. Labeling Instructions:

- a. Indoor Equipment: Engraved, laminated acrylic or melamine nameplate. Unless otherwise indicated, provide a single line of text with 1/2 in. (13 mm) high letters on 1-1/2 in. (37 mm) high nameplate; where two (2) lines of text are required, use nameplates 2 in. (50 mm) high.
- b. Outdoor Equipment: Engraved, laminated acrylic or melamine nameplate.
- c. Elevated Components: Increase sizes of nameplates and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

- a. Panelboards, electrical cabinets, and enclosures.
- b. Access doors and panels for concealed electrical items.
- c. Electrical switchgear and switchboards.
- d. Transformers.
- e. Emergency system boxes and enclosures.
- f. Disconnect switches.
- g. Enclosed circuit breakers.
- h. Motor starters.
- i. Push-button stations.
- j. Power transfer equipment.
- k. Contactors.
- l. Remote-controlled switches, dimmer modules, and control devices.
- m. Power-generating units.
- n. Voice and data cable terminal equipment.
- o. Television/audio components, racks, and controls.
- p. Fire-alarm control panel and annunciators.
- q. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- r. Monitoring and control equipment.

J. Arch Flash and Shock Hazard Analysis:

1. The Contractor shall provide Arch Flash and Shock Hazard Warning Signage on all electrical distribution and control equipment in accordance with 2005 NEC Section 110.16, which requires that panel-boards, enclosed circuit breakers, disconnect switches, control panels, motor controls, etc. that are likely to require examination, adjustment, servicing or maintenance while energized, shall be field marked to warn qualified persons of potential arc flash hazards. The markings shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.
2. This requirement is intended to help reduce the occurrence of serious injury or death due to arcing faults to those working on or near energized electrical equipment. The warning labels are to indicate to a qualified worker who intends to open the equipment for analysis of work that a serious hazard exists and that the worker should follow appropriate work practices and wear appropriate personal protective equipment for the specific hazard.
3. The labels shall include at least the following information: (1) flash hazard boundary; (2) cal/cm² flash hazard at 18 in. (457.2 mm); (3) PPE Level and PPE required to work on the equipment; (4) shock hazard involved; (5) limited

approach boundary; (6) restricted approach boundary; and prohibited approach boundary.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.6 m) maximum intervals in congested areas.
- G. Color-Coding for Phase Identification, 600-Volt and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors:

VOLTAGE	120/208 3-PH, 4-W	277/480 3-PH, 4-W
PHASE A	BLACK	BROWN
PHASE B	RED	ORANGE

PHASE C	BLUE	YELLOW
NEUTRAL (GROUNDED) CONDUCTOR	WHITE	GREY
GROUND CONDUCTOR	GREEN	GREEN

- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 12 in. (300 mm) below finished grade.

END OF SECTION

SECTION 260913

ELECTRICAL POWER MONITORING AND CONTROL

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Eaton / Cutler-Hammer (design basis)
- B. Schneider Electric Powerlogic
- C. Siemens
- D. Alerton

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered.

2.2 PRODUCTS

A. IQ Energy Sentinel

1. Where indicated on drawings (all *L panels), supply a UL listed microprocessor-based Sub Metering Module (SMM), Cutler-Hammer type IQ Energy Sentinel or approved equal having the specified features. The SMM shall be available to directly attach to 400-ampere and below frame size Molded Case Circuit Breakers equivalent to Cutler-Hammer type breakers or shall be panel or DIN-rail mountable where Cutler-Hammer type breakers are not used. Where required for use with a circuit greater than 400 A, a Universal type SMM for use with external current transformers shall be supplied. The SMM shall be suitable for use with single-phase 120/240 V or 3-phase 208Y/120 V or 480Y/277 Vac systems where shown on the drawings
2. The SMM, when utilized with its associated circuit breaker and connected via twisted pair network to the monitoring system computer, shall be capable of providing the following information in units, kilo-units or mega-units as applicable:
 - a. Watts
 - b. Present Watt Demand (5-, 10-, 15-, 30- or 60-minute window)
 - c. Peak Watt Demand (same window as Present Watt Demand)
 - d. Watthours.
3. Accuracy of the SMM shall be +/- 1% of the Breaker Frame rating through a range of 0.1 to 1.25 of the Breaker Frame rating. The SMM shall be suitable for 60-cycle power systems with a Power Factor of from 90-degree lagging to 30-degree leading
4. Communications capability shall be provided to transmit information over a local area network (LAN) at 9,600 baud. The communications network shall be noise immune to 60-cycle power and utilize a non-polarized shielded twisted pair of #18 wires
5. Each SMM shall include all of the following features:

- a. When used with a Cutler-Hammer type circuit breaker 400 amperes and below frame size, have the same width and depth dimensions as its associated molded case breaker along with integral voltage stabs for mounting it directly to the circuit breaker. Device to include built-in neutral and communications terminals and transmit LED.
- b. For circuits 400 A and less, include three (3) built-in integral doughnut current transformers, suitable for having the load side cables passed through and being directly connected to the circuit breaker terminals without decreasing the code required bending space. For loads greater than 400 A, provide three (3) current transformers.
- c. Be powered directly from the monitored circuit and shall not need any separate control power source.
- d. Include integral DIP switches for establishing its address for the monitoring system.

2.3 MICROPROCESSOR-BASED METERING EQUIPMENT – LOCAL NETWORK DISPLAY UNITS

A. Subnetwork Master Local Display (SMLD)

- 1. On switchgear MDP, provide a Subnetwork Master Local Display (SMLD) Cutler-Hammer type SMLD or equal. The SMLD shall be a microprocessor-based, self-contained device (NEMA 3R/12 faceplate) suitable for door mounting and shall perform the following listed functions.
- 2. The assembly shall include a communications module to provide for remote computer monitoring up to 7,500 feet (location of owner computer assumed to be in office space)
 - a. Monitor and display parameters of up to 100 devices with compatible microprocessor-based units; Cutler-Hammer type IQ200, IQ Multipoint Energy Submeter II, IQ Energy Sentinel, IQ Power Sentinel, and OPTIM 1050L trip units. Communications over the local area network shall be 9,600 baud. There shall be separate step-up and step-down buttons to select specific downstream devices by means of an address in a display window. All data locally displayed by downstream devices shall also be displayed at the SMLD and shall be capable of being communicated via twisted pair to a remote personal computer.
 - b. The SMLD shall auto configure to all downstream devices based on the addresses of each downstream device.
- 3. Provide a web-enabled gateway.

END OF SECTION

**SECTION 262200
LOW-VOLTAGE TRANSFORMERS**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Provide dry type transformer as shown on transformer schedules as indicated on drawings.

1.02 SUBMITTALS

- A. Outline dimensions and weights
- B. Wiring Diagrams
- C. Transformer ratings including:
1. kVA
 2. Primary and secondary voltage
 3. Taps (number of and configuration)
 4. Design impedance
 5. Insulation class and temperature rise
 6. Sound level.
- D. Product data sheets
- E. Linear (resistive) load efficiencies at 25%, 50%, 75% and 100% of full-load current rating
- F. Linear (resistive) load efficiencies, taken per NEMA TP-2 measurement requirements, shown in comparison to NEMA TP-1-2002 reference levels
- G. Non-Linear load efficiencies per manufacturer's Non-Linear Load Testing Procedures, witnessed by a third-party Equipment Testing & Certification Company (as per section below entitled, "Third Party Validation & Non-Linear Load Testing Procedures").
- H. To ensure valid information for Regulated Load Loss of the transformer, the transformer's No-Load Losses shall be no more than that listed in the following watt loss table:

Transformer kVA Rating	No-Load Losses - Typical (watts)
15	80
30	90
45	140
75	220
112.5	340
150	420
225	560
300	740

500	880
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- I. To ensure a quality product offering and as representative of product line performance - the manufacturer shall provide transformer efficiency and watt loss (measured per manufacturer's Non-Linear Load Testing Procedures and witnessed by a third-party Equipment Testing & Certification:
 1. 100% Linear (resistive) load
 2. 50%/50% mix (or as close as possible depending on loading mix with combination of load to have k-factor between linear (resistive) and Non-linear (computer) loads)
 3. 100% Non-Linear (computer) load mix

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Transformers shall be by same manufacturer as panelboards.

2.02 EQUIPMENT REQUIREMENTS

- A. General purpose dry type transformers shall be of the two-winding type, self-cooled, with ratings (KVA) as indicated on the drawings. Transformers shall be built in accordance with applicable NEMA, ANSI, IEEE, OSHA, UL standards.
- B. Sound levels for the 500 kVA transformer shall not exceed 60 db.
- C. Transformer shall be no less than 98% percent efficient with non-linear load at 25%, and 50% of nameplate rating. Provide documentation of third party test results indicating efficiencies at various loads, with non-linear loading up to 20% THD current, mostly triplen harmonics,
- D. Transformer to be provided with six (6) 2-1/2% full capacity taps--two above and four below primary rated voltage.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide flexible conduit to and from transformer.
- B. Install transformers in accordance with manufacturer's recommendations. Level and anchor securely to 4" high chamfer edge concrete pad.
- C. Ground secondary neutral of all transformers to grounding conductor in primary feeder and to building steel or other approved electrode using grounding electrode conductor sized in accordance with NEC. Ground transformer enclosure with bonding jumper.
- D. Provide both primary and secondary protection by use of fuses or circuit breakers as shown on drawings.

END OF SECTION

SECTION 262413
LOW VOLTAGE SWITCHBOARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Service and distribution switchboards rated 600 V and less.
 - 2. Transient voltage suppression devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Instrumentation.
 - 5. Control power.
 - 6. Accessory components and features.
 - 7. Identification.

1.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified [and the unit will be fully operational after the seismic event]."

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards.
 - 3. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and maintenance data.

1.04 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. Comply with NEMA PB 2.
- C. Comply with NFPA 70.
- D. Comply with UL 891.

1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Schneider Electric.
- C. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: [Panel] [Fixed, individually] mounted.
 - 2. Branch Devices: Panel mounted.
 - 3. Sections front and rear aligned.
- D. Enclosure: Steel, NEMA 250, Type 1.
 - 1. Enclosure Finish: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
 - 2. Enclosure: Flat roof; bolt-on rear covers for each section, with provisions for padlocking.
- E. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- F. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- G. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

- H. Phase and Neutral Buses and Connections: Three phase, four wire unless otherwise indicated. Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
 - 1. Ground Bus: 1/4-by-2-inch- minimum size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors.
 - 2. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 3. Neutral Buses: [50] percent of the ampacity of phase buses unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables.
- I. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.02 SURGE PROTECTIVE DEVICE

- 1. See section 264313.

2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 400 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers (400-ams and larger): Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - 4. Service-Rated Switches: Labeled for use as service equipment.

2.04 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
 - 1. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 2. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.

- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.05 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.06 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Receive, inspect, handle, store and install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03.

1. 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.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 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 switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Install filler plates in unused spaces of panel-mounted sections.
- E. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
1. Set field-adjustable switches and circuit-breaker trip ranges.

3.02 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.03 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- B. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Switchboard will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION

SECTION 262416
PANELBOARDS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide circuit breaker type panelboards as indicated on drawings and as specified in this section.

1.02 SUBMITTALS

- A. Product Data: For each type of panelboard, accessory item, and component specified.
- B. Shop Drawings: For panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:
1. Enclosure type with details for types other than NEMA 250, Type 1.
 2. Bus configuration and current ratings.
 3. Short-circuit current rating of panelboard.
 4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Lighting and Appliance Branch Circuit Panelboards:

<u>MANUFACTURER</u>	<u>277/480 VOLT</u>	<u>120/208 VOLT</u>
Square D	Type NF	Type NQOD
Eaton Cutler-Hammer	Type PRL2A	Type PRL1A
Siemens	Type S2	Type S1

- B. Distribution Panelboards (Power Panelboards):

<u>MANUFACTURER</u>	<u>277/480 VOLT</u>	<u>120/208 VOLT</u>
Square D	I-LINE series	I-LINE series
Eaton Cutler-Hammer	Type PRL4B	Type PRL4B
Siemens	Type S4	Type S4

2.02 PANELBOARD FABRICATION

- A. Enclosures: Flush- or surface-mounted cabinets as indicated. NEMA PB 1, Type 1, unless otherwise indicated to meet environmental conditions at installed location.
- B. Front: Secured to box with concealed trim clamps, unless otherwise indicated. Front for surface-mounted panelboards shall be same dimensions as box. Fronts for flush panelboards shall overlap box, unless otherwise indicated.
- C. Directory Frame: Metal, mounted inside each panelboard door.
- D. Bus: Copper
- E. Main and Neutral Lugs: Mechanical Type.
- F. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.
- G. Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the overcurrent protective device ampere ratings indicated for future installation of devices.
- H. Special Features: Include the following features for panelboards as indicated:
 - 1. Hinged Front Cover: Entire front trim hinged to box with standard door within hinged trim cover.
- I. Feed-through Lugs: Sized to accommodate feeders indicated.

2.03 LIGHTING AND APLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Circuit Breakers: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: In panelboard front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

2.04 DISTRIBUTION PANELBOARDS ("DP" IN NAME)

- A. Doors: No Doors unless otherwise noted on panel schedule
- B. Feeder and Branch-Circuit Breakers: Where overcurrent protective devices are indicated to be circuit breakers, use bolt-on circuit breakers.

2.05 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.
 - 1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
 - 2. Application Listing: Appropriate for application, including Type SWD for switching fluorescent lighting loads and Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
 - 4. Shunt Trip: Where indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install panelboards and accessory items according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish.
- D. Circuit Directory: Type directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval from Owner before installing.
- E. Install filler plates in unused spaces.
- F. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

3.02 IDENTIFICATION

- A. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws. Include "panel name", "Feeder Size", and "Fed From" fields in name plate.
- B. Provide typed directory cards mounted under plastic on the doors of all panelboards. The directories shall indicate the type of devices being served, including the owner's space number or space names in which the devices or fixtures are located. Information on the directory card shall include name and location of the panelboard or switchgear serving this panelboard.
- C. Provide engraved phenolic nameplates for all the circuit breakers in use on power panelboards. Indicate the device, panel, or motor being served with 1/4" high letters. Provide nameplates without engraving for the spare breakers and/or spaces. Secure all nameplates to the panelboard trim with two roundhead sheet metal screws.

3.03 GROUNDING

- A. Make equipment grounding connections for panelboards as indicated.
- B. Provide ground continuity to main electrical ground bus as indicated.
- C. Ground separate ground bars to panel boxes and to the main service entrance ground bus with a code-sized grounding conductor installed in the same conduit as the phase and neutral conductors. See Section 16450, Grounding.
- D. Bond ground buses together in two-section panelboards. Bonding conductor shall be copper, and of the same size as the feeder grounding conductor serving that panelboard.

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 FIELD QUALITY CONTROL

- A. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.
- B. Balancing Loads: After Substantial Completion, but not more than 2 months after Final Acceptance, conduct load-balancing measurements and make circuit changes as follows:
 - 1. Perform measurements during period of normal working load as advised by Owner.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as required to meet this minimum requirement.

END OF SECTION

**SECTION 262500
BUSWAY- LOW VOLTAGE**

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install the busway system including all necessary fittings, hangers and accessories as specified herein and as shown on the contract drawings.

1.02 REFERENCES

- A. The low voltage busway and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards of ANSI and NEMA:
1. NEMA BU.1
 2. ANSI/UL 857
 3. CSA

1.03 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
1. Master drawing index
 2. Isometric drawing of each busway run
 3. Component list
 4. Busway ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 5. Major component ratings including:
 - a. Voltage
 - b. Continuous current
 - c. Interrupting ratings
 6. Cable terminal sizes
 7. Product data sheets

1.04 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
 2. Certified production test reports
 3. Installation information

4. Seismic certification and equipment anchorage details

1.05 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. Provide Seismic tested equipment as follows:
 - 1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest International Building Code (IBC).
 - 2. The Project Structural Engineer will provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.
 - 3. The IP rating of the equipment shall be 1.5
 - 4. The Structural Engineer for the Site will evaluate the SDS values published on the Manufacturer's website to ascertain that they are "equal to" or "greater than" those required for the Project Site.
 - 5. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
 - a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
 - b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
 - c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.06 REGULATORY REQUIREMENTS

- A. The busway shall bear a UL label.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.08 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

1.09 EXTRA PRODUCTS

- A. Spare parts shall be furnished for each rating of busway, consisting of:
 - 1. One set of joint covers for each busway

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton
- B. General Electric
- C. Siemens
- D. Schneider Electric

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 RATINGS

- A. The busway shall have a minimum of 6-cycle short-circuit rating of 85 kA RMS symmetrical for ratings through 800 Amp, 100 kA RMS symmetrical for ratings through 1350 Amp, 125 kA RMS symmetrical for ratings through 1600 Amp, 150 kA RMS symmetrical ratings through 2500 Amp, and 200 kA RMS symmetrical for ratings through 5000 Amp.

2.03 CONSTRUCTION

- A. The busway and associated fittings shall consist of aluminum conductors totally enclosed in a 2-piece extruded aluminum housing. Outdoor feeder, indoor feeder and indoor plug-in busway shall be interchangeable at the same rating without the use of adapters or special splice plates. Where indicated on the drawings provide indoor, sprinkler-proof plug-in busway. Fittings –(elbows, tees, flanges, etc.) shall be identical for use with both the plug-in and feeder types of busway. The busway shall be capable of being mounted flat-wise, edgewise, or vertically without derating.
- B. The busway shall consist of standard 10-foot sections with special sections and fittings provided to suit the installation. Horizontal runs shall be suitable for hanging on 10-foot maximum centers.

- C. Vertical runs shall be suitable for mounting on 16-foot maximum centers.
- D. Provide one (1) hanger for every ten (10) feet of horizontally mounted duct. On vertical runs provide one adjustable hanger per floor.

2.04 BUS

- A. Bus bars shall be fabricated from high strength, 55% conductivity aluminum and suitably plated at all electrical contact surfaces.
- B. Bus bars shall be insulated over their entire length, except at joints and contact surfaces, with a UL listed insulating material consisting of a thermo set epoxy applied by fluidized bed process. Tape or heat-shrink sleeve insulation, or any other method of insulation, which can allow air-gaps or insulation breakdown, shall not be acceptable.
- C. The busway shall be capable of carrying rated current continuously without exceeding a temperature rise of 55 degrees C based on a 40 degrees C ambient.

2.05 BUS JOINTS

- A. Each busway section shall be furnished complete with joint hardware and covers. The busway joints shall be a single-bolt, non-rotating, removable bridge design. All bridge joints shall be furnished with torque-indicating double head joint bolts and Belleville washers. The bridge joint shall utilize a captive nut retainer on the opposite side of the torque-indicating bolt. The bridge joint design shall ensure proper installation without the use of a torque wrench, and provide visual indication that the joint has been tightened to the proper torque value. Each busway joint shall allow for a minimum length adjustment of +/- 0.5 inches. De-energization of busway shall not be required for safe testing of joint tightness.

2.06 HOUSING

- A. The busway housing shall be a 2-piece design fabricated from extruded aluminum. The 2-piece housing shall be bolted together, along the bottom flange, using grade 5, 1/4x20 zinc-plated fasteners on 3-inch centers for maximum mechanical strength. The busway enclosure finish shall be ANSI 61 gray baked epoxy powder paint applied by an electrostatic process.
- B. Outdoor feeder busway housing shall be identical to indoor feeder busway housings, and shall be UL listed for outdoor use. Busway shall be completely weatherized at the factory, and designed such that only caulking of protective joint covers are required for outdoor application.

2.07 PLUG-IN BUSWAY

- A. Where required, busway shall be of the plug-in type. Plug-in busway shall be available in standard 2-, 4-, 6-, 8- and 10-foot lengths, with plug-in openings provided on both sides of the busway sections on 24-inch centers. Plug-in covers shall prohibit dirt and debris from entering contact plug-in openings in the busway. The design shall allow for ten (10) hinged cover outlets per ten (10) feet of plug-in length, and covers shall be field-convertible to hinge on either side. Covers for plug-in openings shall have a positive screw close feature and provisions for installation of power company seals. The contact surfaces for bus plug stabs

- shall be silver-plated and of the same material, thickness, and rating as the phase bars. The tabs shall be welded to the bus bars. A standard housing ground connection shall be supplied in each plug-in opening. Positive mechanical guides for plug-in units shall be provided at each plug-in opening to facilitate unit alignment and prevent improper installation.
- B. Where required, plug-in units of the types and ratings indicated on the plans and specifications shall be supplied. Plug-in units shall be mechanically interlocked with the busway housing to prevent their installation or removal while the switch is in the "ON" position. The enclosure of any plug-in unit shall make positive ground connection to the duct housing before the stabs make contact with the bus bars. All plug-in units shall be equipped with an interlock that can be defeated to prevent the cover from being opened while the switch is in the "ON" position and to prevent accidental closing of the switch while the cover is open. The plugs shall be provided with a means for padlocking the cover closed and padlocking the disconnect device in the "OFF" position. The operating handle and mechanism shall remain in control of the disconnect device at all times, permitting its easy operation from the floor by means of a hook stick or chain. All plug-in units shall be interchangeable without alteration or modification of plug-in duct.
 - C. Fusible-type plugs shall have a quick-make/quick-break disconnect switch and positive pressure fuse clips

2.08 WARRANTY

- A. The equipment shall be warranted from defects for a period of (24) months from start-up or (30) months from shipment, whichever occurs first.

PART 3 EXECUTION

3.01 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
- B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.02 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- A.

END OF SECTION

SECTION 262726
WIRING DEVICES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. All work specified in this section shall comply with the provisions of Section 260500.
- B. Provide switches, receptacles, and other wiring devices and plates as indicated on drawings.

PART 2 PRODUCTS

2.01 GENERAL

A. ACCEPTABLE MANUFACTURERS

Provide devices and plates by Hubbell, Leviton, Bryant, Eagle, Arrow-hart, Pass and Seymour, General Electric, Lutron and Wiremold. Provide named manufactured products unless an equal product has been approved.

B. FINISHES

Provide device and plate colors as specified by the Architect.

2.02 RECEPTACLES

- A. Straight-Blade and Locking Receptacles: General-Duty grade; 20-amp, 125-volt, NEMA 5-20R (L5-20R for locking) unless otherwise noted.
- B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit.
- C. TVSS Receptacles: Duplex type, NEMA WD 6, Configuration 5-20R, with integral TVSS in line to ground, line to neutral, and neutral to ground.
 - 1. TVSS Components: Multiple metal-oxide varistors; rated a nominal clamp level of 500 transient-suppression voltage and minimum single transient pulse energy dissipation of 140 J line to neutral, and 70 J line to ground and neutral to ground.
 - 2. Active TVSS Indication: Light visible in face of device to indicate device as "active" or "no longer active."
 - 3. Identification: Distinctive marking on face of device denotes TVSS-type unit.

2.03 SWITCHES

- A. Snap Switches: General-duty, quiet type.
- B. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 - 1. Switch: 20 A, 120/277-V ac.
 - 2. Receptacle: NEMA WD 6, Configuration 5-15R.
- C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters. Wattage to suit connected load.
 - 1. Control: Continuously adjustable slide, toggle, or rotary knob. Single-pole or three-way switch to suit connections.

2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz, electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch (130-mm) wire connecting leads.
3. Fluorescent Lamp Dimmers: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming to a maximum of 1 percent of full brightness.

2.04 WALL PLATES

- A. Single and combination types match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Nylon
 3. Material for Unfinished Spaces: Galvanized steel.

2.05 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartmentation: Barrier separates power and signal compartments.
- C. Housing Material: Die-cast aluminum, satin finished.
- D. Power Receptacle: NEMA WD 6, Configuration 5-20R.
- E. Signal Outlet: Blank cover with bushed cable opening, unless otherwise indicated.

2.06 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box unit with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
 1. Size: Selected to fit nominal 3-inch (75-mm) cored holes in floor and matched to floor thickness.
 2. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 3. Closure Plug: Arranged to close unused 3-inch (75-mm) cored openings and reestablish fire rating of floor.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- F. Protect devices and assemblies during painting.
- G. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

3.02 CONNECTIONS

- A. Connect wiring device grounding terminal to outlet box with bonding jumper.
- B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Check TVSS receptacle indicating lights for normal indication.
- C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- D. Replace damaged or defective components.

3.04 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers.
 - 4. Enclosures.

1.02 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
- B. Shop Drawings: For each switch and circuit breaker.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Current and voltage ratings.
 - c. Short-circuit current rating.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports and include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Manufacturer's field service report.
- F. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 01. In addition to requirements specified in Division 01 Section "Closeout Procedures," include the following
 - 1. Routine maintenance requirements for components.

2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
3. Time-current curves, including selectable ranges for each type of circuit breaker.

1.03 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Corporation; Cutler Hammer Products
 2. General Electric Co.; Electrical Distribution & Protection Div.
 3. Siemens Energy & Automation, Inc.
- B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position. Interrupting capacity shall meet available fault currents, series rated equipment is not acceptable.
- C. Enclosed, Nonfusible Switch: NEMA KS 1, Type [GD] [HD], lockable handle with capability to accept two padlocks, and interlocked with cover in closed position. Interrupting capacity shall meet available fault currents, series rated equipment is not acceptable.
- D. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
 3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.02 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. General Electric Co.; Electrical Distribution & Control Division.
 2. Siemens Energy & Automation, Inc.
 3. Square D/Group Schneider.
- B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents, series rated equipment is not acceptable.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I₂t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
 5. GFCI Circuit Breakers: Single- and two-pole configurations with 5 to 30 mA trip sensitivity.
 6. Molded-Case Switch: Molded-case circuit breaker without trip units.
 7. Molded-Case Circuit-Breaker Features and Accessories:
- C. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles. The Molded-Case Circuit-Breakers shall have features as appropriate for the specific application used.
1. Lugs: Mechanical or compression style suitable for number, size, trip ratings, and material of conductors.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system.
 5. Under voltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 6. Auxiliary Switch: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 8. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

2.03 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. Outdoor Locations: NEMA 250, Type 3R.
 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.04 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosures before shipping.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.
- C. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- D. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- E. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- F. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- G. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- H. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

3.02 CONNECTIONS

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.
- C. 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 and UL 486B.

3.03 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.
 - 4. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
 - 5. Test continuity of each line- and load-side circuit.

- B. Testing Agency: Engage a qualified independent testing agency to perform specified testing.
- C. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each unit 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies switches and circuit breakers checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.04 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.05 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 264100
LIGHTNING PROTECTION SYSTEMS

PART 1 - GENERAL

The Contractor shall provide and install a complete Lightning Protection System for the building(s) in this project.

- A. The building is a steel structure with EIFS and glass façade.
- B. All mechanical equipment outside the building are to be considered part of the protected premises. This includes the packaged generator and all roof-top equipment

1.02 Compliance Requirements:

- A. System Design:
 - 1. NFPA 780 Standard, latest edition
- B. Component Design
 - 1. UL 96 Standard
- C. Certification:
 - 1. UL Master Label
 - 2. L.P.I. Certificate

1.03 Submittals:

- A. Complete Shop Drawings.
 - 1. Layout
 - 2. Details
- B. Catalog Data, with complete description of material components.

PART 2 - PRODUCTS

2.01 Acceptable Manufacturers

- A. A-C Lightning Security, Inc. Maryville, MO. (phone: 800-821-5575 fax: 660-562-2932).
- B. Pre-approved Manufacturer of the Lightning Protection Institute.

2.02 Materials listed and labeled in accordance with Underwriters' Laboratories requirements.

PART 3 - SYSTEM DESIGN

3.01 System to consist of groundings, down conductors, air terminals, interconnecting conductors, and bonding as required, designed to appear as a part of the building.

- A. Steel framing (minimum 3/16" thick) may be used for the Lightning Protection Component if electrically continuous, or made so.
- B. Cable system to be utilized if building construction is not structural steel columns.

3.02 Design to be complete per current NFPA 780 requirements:

- A. Class I materials required if structure is under 75' in height.
- B. Aluminum materials not to be embedded in concrete or masonry or installed on copper surfaces.
- C. Bare copper materials not to be installed aluminum surfaces.
- D. Grounding shall be suitable for the soil conditions per NFPA 780 Standard, this may include:
 - 1. Ground loop only (full size cable) for any height structure.
 - 2. Ground loop combined with rods or plates for any height structure.
- E. Air Terminal:
 - 1. Minimum 10" projection above the object protected.
 - 2. Maximum 20' spacing on roof ridges or edges.
 - 3. Maximum 24" from ridge ends or edges & outside corners.
 - 4. Midroof areas are to be provided with air terminals of sufficient quantity and height, to insure the entire roof area is covered by a "zone of protection" as afforded by a 150 foot radius "Ball", per NFPA 780 Standard.
- F. Bonding is required in strict accordance with NFPA 780 Standard.
 - 1. Ground level potential equalization; below the 12' elevation of the all grounded media to be interconnected.
 - 2. Ground loop required for structures over 60' in height.
 - 3. Roof levels over 60' to include interconnection of all grounded media within 12' of the main roof level.
 - 4. Intermediate levels:
 - a. Steel-framed structures - Intermediate loops not required.
 - b. Reinforced concrete - Loop at 200' (vertical height) intervals required connecting all grounded systems.
 - c. Other structures Intermediate Loops at levels not exceeding 60' intervals, connecting all grounded media at loop height.
 - 5. For Cable Downlead systems, the reinforcing and continuous structural steel shall be connected to all down conductors at bottom & top of building and all intermediate loops.

3.03 Surge Protective Devices (SPD) to be provided on all electrical communication service entrances and on communication antenna lead-ins. Proper protection may only be provided by communication systems supplier.

PART 4 - INSTALLATION

- 4.01** Installation shall be by an L.P.I. Certified Master Installer Underwriters' Laboratories listed Installer or under supervision thereof.
- 4.02** Installation shall be complete per requirements of Standard NFPA 780.
- 4.03** Installation shall be neat and inconspicuous.
- 4.04** All mounting and penetration of roof surface shall be coordinated with roofing contractor to assure maximum roofing guarantee. All special items required for various roof manufacturers guarantees are to be provided and installed by the roofing contractor.
- 4.05** Fasteners:

- A. At 3' centers on exposed conductor.
- B. As necessary to maintain position and permanently in place on concealed runs of conductor.

PART 5 - FINAL ACCEPTANCE

- 5.01** Procurement of Underwriters' Laboratories Master Label indicating the following has been completed:
 - A. Showing owner or his representative the type and manner of placing groundings.
 - B. Completing application form and submitting to Underwriters' Laboratories for issue of Label.
- 5.02** Procurement of L.P.I. Certification includes UL requirements above plus the following:
 - A. Witness of grounding System & Grade bonding (Stage I).
 - B. Inspection of concealed equipment between roof & grade (Stage II).
 - C. Final inspection of exposed equipment on roof (Stage III).
- 5.03** Installation of Installer's Nameplate near electric service center.
- 5.04** Any components or methods found not to be in accordance with this specification shall be repaired or replaced without cost to the owner.

END OF SECTION

SECTION 264313

LOW VOLTAGE AC SURGE PROTECTION FOR ELECTRICAL DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in:

1.02 REFERENCES

- A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

1.03 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
 2. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.
- B. Where applicable the following additional information shall be submitted to the engineer:
1. Descriptive bulletins
 2. Product sheets

1.04 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
1. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process

1.05 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.07 OPERATION AND MAINTENANCE MANUALS

- A. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Cutler-Hammer
- B. Liebert
- C. Current Technology
- D. General Electric

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 VOLTAGE SURGE SUPPRESSION – GENERAL

- A. Electrical Requirements
 - 1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
 - 2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 125% of the nominal system operating voltage.
 - 3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells,

air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

Configuration	Protection Modes			
	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

MODES	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
 - a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
 - i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
 - ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
 - iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
 - b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
 - c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
 - d. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of $50 \pm 20A$ occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
 - i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
6. Overcurrent Protection
 - a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
8. Safety Requirements
 - a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
 - b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.
 - c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.03 SYSTEM APPLICATION

- A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGORY	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

- C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.04 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

- A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
3. The panelboard shall be capable of re-energizing upon removal of the SPD.
4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
6. The SPD shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the SPD shall be UL67 listed.

- B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)

1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

- C. Switchgear, Switchboard, MCC and Busway Requirements

1. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway
3. The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.05 ENCLOSURES

- A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:
 1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
 2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only)
 3. NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only)

PART 3 EXECUTION

3.01 EXAMINATION

3.02 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.03 INSTALLATION

- A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.04 WARRANTY

- A. The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

3.05 DESCRIPTION

- A. The specified unit shall provide effective high energy transient voltage surge suppression, surge current diversion and high frequency noise attenuation in all electrical modes for equipment connected downstream from the facility's meter or load side of the main overcurrent device. The unit shall be connected in parallel with the facility's wiring system, hardwired to the main bus of the main electrical distribution panel.

END OF SECTION

SECTION 265100

LIGHTING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide labor, material, equipment and services necessary for complete lighting system including all lighting fixtures, necessary hangers and lamps.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings].
- B. See lighting fixture schedule on drawings for specific fixtures required. PRODUCTS IN STRICT COMPLIANCE WITH THE SPECIFICATIONS AND MANUFACTURED BY OTHERS NOT NAMED WILL BE CONSIDERED ONLY IF PRE-APPROVED BY THE ENGINEER TEN (10) DAYS PRIOR TO BID DATE. PRE-APPROVAL DOES NOT RELIEVE THE CONTRACTOR FROM THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.

2.02 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598.
- C. Fluorescent Fixtures: Comply with UL 1598.
- D. HID Fixtures: Comply with UL 1598.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- G. 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.
- H. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
 - b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

2.03 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. General Requirements for Electronic Ballasts:
 1. Comply with UL 935 and with ANSI C82.11.
 2. Designed for type and quantity of lamps served.
 3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
 4. Sound Rating: Class A.
 5. Total Harmonic Distortion Rating: Less than 20 percent.
 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 7. Operating Frequency: 42 kHz or higher.
 8. Lamp Current Crest Factor: 1.7 or less.
 9. BF: 0.88 or higher, UON.
 10. Power Factor: 0.95 or higher.
- B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.
- C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
 1. Ballast Manufacturer Certification: Indicated by label.
- D. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.
- E. Ballasts for Low-Temperature Environments: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
- F. Ballasts for Residential Applications: Fixtures designated as "Residential" may use low-power-factor electronic ballasts having a Class B sound rating and total harmonic distortion of approximately 30 percent.
- G. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
 1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
 4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.
- H. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.
 1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 30 percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.04 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
 1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: Class A.
 4. Total Harmonic Distortion Rating: Less than 20 percent.
 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. BF: 0.95 or higher unless otherwise indicated.
 9. Power Factor: 0.95, or higher.
 10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.05 EMERGENCY FLUORESCENT POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
 1. Emergency Connection: Operate one fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Nightlight Connection: Operate one fluorescent lamp continuously.
 3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.06 BALLASTS FOR HID LAMPS

- A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:
 1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
 3. Rated Ambient Operating Temperature: 104 deg F.

4. Open-circuit operation that will not reduce average life.
- B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
1. Minimum Starting Temperature: Minus 20 deg F for single-lamp ballasts.
 2. Rated Ambient Operating Temperature: 130 deg F.
 3. Lamp end-of-life detection and shutdown circuit.
 4. Sound Rating: Class A.
 5. Total Harmonic Distortion Rating: Less than 20 percent.
 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 7. Lamp Current Crest Factor: 1.5 or less.
 8. Power Factor: 0.90 or higher.
 9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 10. Protection: Class P thermal cutout.
- C. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
 2. Minimum Starting Temperature: Minus 40 deg F.

2.07 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.08 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures, where shown on schedule.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage, where shown on schedule.

2.09 FLUORESCENT LAMPS

- A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500K, and average rated life 20,000 hours unless otherwise indicated.
- B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500K, and average rated life of 20,000 hours unless otherwise indicated.
- C. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500K, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.
 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
 6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
 7. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

2.010 HID LAMPS

- A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900K, and average rated life of 24,000 hours, minimum.
- B. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and color temperature 4000K.
- C. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000K.
- D. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000K.
- E. Low-Pressure Sodium Lamps: ANSI 78.41, CRI 0, and color temperature 1800 K.

2.011 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Comply with NFPA 70 for minimum fixture supports.
- C. Fixtures shall be securely mounted as required by NEC Article 410, and as specified herein.
- D. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- E. Recessed fixtures mounted in a suspended ceiling:
 - 1. Support with approved hanging wire at two diagonally opposite corners.
 - 2. Recessed down-light fixtures mounted in a suspended ceiling shall be supported with one approved hanging wire.
 - 3. 2x4 fixtures mounted in a suspended ceiling shall be secured to the grid with approved clips as required by the NEC.
- F. Fixtures shall be mounted in locations as shown on architectural reflected ceiling drawings. Coordinate with structural members, piping and ductwork locations for interferences and notify architect of any interferences that cannot be avoided by minor adjustments in location.
- G. Mount fixtures as called for in schedule on electrical drawings. Determine type of ceiling to be installed in each space from architectural drawings and schedules and furnish fixtures suitable for the exact type.
- H. Receive, store, uncrate, and install lighting fixtures shown in schedule on drawings to be furnished by others.

- I. Adjustable type fixtures shall be adjusted by the Contractor to illuminate intended area to satisfaction of Owner.
- J. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- K. Adjust aimable lighting fixtures to provide required light intensities.

3.02 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

SECTION 28 13 00
ACCESS CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Access control system requirements.
- B. Access control units and software.
- C. Access control point peripherals, including readers.
- D. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 08 71 00 - Door Hardware: Electrically operated door hardware, for interface with access control system.
- C. Section 14 21 00 - Electric Traction Elevators: For interface with access control system.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- E. Section 26 05 33.13 - Conduit for Electrical Systems.
- F. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 27 10 00 - Structured Cabling: Data cables for access control system IP network connections.
- H. Section 28 46 00 - Fire Detection and Alarm: For interface with access control system.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 101 - Life Safety Code; 2015.
- D. UL 294 - Access Control System Units; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other installers to provide suitable door hardware as required for both access control functionality and code compliance.
 - 2. Coordinate the placement of readers with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 3. Coordinate the work with other installers to provide power for equipment at required locations.
 - 4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Preinstallation Meetings:
 - 1. Conduct meeting with facility representative to review reader and equipment locations.
 - 2. Conduct meeting with facility representative and other related equipment manufacturers to discuss access control system interface requirements.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include elevations and details of proposed equipment arrangements. Include system interconnection schematic diagrams. Include requirements for interface with other systems.

- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include ratings, configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.
- D. Design Data: Standby battery/UPS calculations.
- E. Certify that proposed system design and components meet or exceed specified requirements.
- F. Evidence of qualifications for installer.
- G. Evidence of qualifications for maintenance contractor (if different entity from installer).
- H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- I. Manufacturer's detailed field testing procedures.
- J. Field quality control test reports.
- K. Maintenance contracts.
- L. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.
- M. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- N. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- O. Software: One copy of software not resident in read-only memory.
- P. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Deliver blank credentials to Owner as directed.

1.06 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70.
 - 2. NFPA 101 (Life Safety Code).
 - 3. The requirements of the local authorities having jurisdiction.
 - 4. Applicable TIA/EIA standards.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with access control systems of similar size, type, and complexity and providing contract maintenance service as a regular part of their business; authorized manufacturer's representative.
 - 1. Contract maintenance office located within 100 miles of project site.
- E. Maintenance Contractor Qualifications: Same entity as installer.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Access Control System - Basis of Design: Lenel or Software House.
- B. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- C. Source Limitations: Where possible, furnish system components and accessories produced by a single manufacturer and obtained from a single supplier.

2.02 ACCESS CONTROL SYSTEM REQUIREMENTS

- A. Provide new access control system consisting of all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. System Battery Backup: Provide batteries/uninterruptible power supplies (UPS) as required for 30 minutes full operation.
- C. Surge Protection:
 - 1. Provide surge protection for readers and door strikes/locks.
 - 2. Provide equipment power surge protection where electrical distribution system surge protection is not provided.
- D. Computers Required:
 - 1. See article "ACCESS CONTROL UNITS AND SOFTWARE" below for product descriptions.
 - 2. Server(s):
 - a. Quantity: One.
 - b. Location(s): To be determined.
 - c. Peripherals required for each server:
 - 1) Mouse and keyboard.
 - 2) Monitor(s): One.
 - 3) Speakers (where not integral with monitor).
 - 3. Badging Station Computer(s):
 - a. Quantity: One.
 - b. Location(s): To be determined.
 - c. Peripherals required for each badging station computer:
 - 1) Mouse and keyboard.
 - 2) Monitor(s): One.
 - 3) Speakers (where not integral with monitor).
 - 4) Badging printer.
 - 5) Badging camera.
 - 6) Badging signature tablet.
- E. Interface with Other Systems:

1. Provide products compatible with other systems requiring interface with access control system.
 2. Interface with electrically operated door hardware as specified in Section 08 71 00.
 - a. Capable of locking/unlocking/releasing controlled doors.
 - b. Capable of receiving input from integral door hardware switches.
 3. Interface with elevators as specified in Section 14 24 00.
 - a. Capable of controlling access to elevator.
 - b. Capable of controlling elevator access to designated floors.
 4. Interface with fire alarm system as specified in Section 28 46 00.
 - a. Capable of affecting access for designated doors for selected fire alarm system events.
- F. Provide products listed, classified, and labeled as suitable for the purpose intended.
1. Access Control Units and Readers: Listed and labeled as complying with UL 294.

2.03 ACCESS CONTROL UNITS AND SOFTWARE

- A. Provide access control units and associated software compatible with readers to be connected.
- B. Computers:
1. Workstation Computers: Unless otherwise indicated, workstation computer hardware and associated peripherals not furnished by access control system manufacturer to be provided by Contractor as part of work of this section, meeting access control system equipment manufacturer's recommended requirements.
 2. Servers: Unless otherwise indicated, server hardware and associated peripherals not furnished by access control system manufacturer to be provided by Contractor as part of work of this section, meeting access control system equipment manufacturer's recommended requirements.
 3. Badging Peripherals: Unless otherwise indicated, badging peripherals not furnished by access control system manufacturer to be provided by Contractor as part of work of this section.
- C. Software:
1. Unless otherwise indicated, provide all software and licenses required for fully operational system.

2.04 ACCESS CONTROL POINT PERIPHERALS

- A. Provide devices compatible with control units.
- B. Provide devices suitable for operation under the service conditions at the installed location.
- C. Provide readers compatible with credentials to be used.
- D. Reader Color: To be selected by Architect from manufacturer's available standard colors.
- E. Door Position Switches:
1. Magnetic Contacts: Encapsulated reed switch(es) and separate magnet; designed to monitor opened/closed position of doors.
 2. Contact Color: To be selected by Architect from manufacturer's available standard colors.
- F. Door Locking Devices (Electric Strikes and Magnetic Locks): Comply with Section 08 71 00.

2.05 ACCESSORIES

- A. Provide components as indicated or as required for connection of access control system to devices and other systems indicated.
- B. Unless otherwise indicated, credentials to be provided by Contractor.
1. Provide credentials compatible with readers and control units/software to be used.
- C. Unless otherwise indicated, network switches required for network connections to system components to be provided by Contractor.
- D. Provide cables as indicated or as required for connections between system components.

1. Data Cables for IP Network Connections: Unshielded twisted pair (UTP), minimum Category 5e, complying with Section 27 10 00.

E. Provide accessory racks/cabinets as indicated or as required for equipment mounting.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive system components.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to system.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install access control system in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Wiring Method: Unless otherwise indicated, use cables (not in conduit).
 1. Use suitable listed cables in wet locations, including underground raceways.
 2. Use suitable listed cables for vertical riser applications.
 3. Use listed plenum rated cables in spaces used for environmental air.
 4. Install wiring in conduit for the following:
 - a. Where required for rough-in.
 - b. Where required by authorities having jurisdiction.
 - c. Where exposed to damage.
 - d. Where installed outside the building.
 - e. For exposed connections from outlet boxes to devices.
 5. Conduit: Comply with Section 26 05 33.13.
 6. Conceal all cables unless specifically indicated to be exposed.
 7. Use power transfer hinges complying with Section 08 71 00 for concealed connections to door hardware.
 8. Cables in the following areas may be exposed, unless otherwise indicated:
 - a. Equipment closets.
 9. Route exposed cables parallel or perpendicular to building structural members and surfaces.
 10. Do not exceed manufacturer's recommended maximum cable length between components.
- D. Provide grounding and bonding in accordance with Section 26 05 26.
- E. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- F. Identify system wiring and components in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
- C. Prepare and start system in accordance with manufacturer's instructions.
- D. Program system parameters according to requirements of Owner.
- E. Test for proper interface with other systems.

- F. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
- C. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Instructor: Manufacturer's authorized representative.
 - 3. Location: At project site.

3.06 PROTECTION

- A. Protect installed system components from subsequent construction operations.

3.07 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner, a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of access control system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- C. Conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.
- D. Provide trouble call-back service upon notification by Owner:
 - 1. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 - 2. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

END OF SECTION

SECTION 283111
FIRE ALARM SYSTEM

PART 1 – GENERAL

1.01. SUMMARY

- A. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.
- B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.
- C. The Fire Detection and Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:
 - 1. Fire alarm and detection operations
 - 2. Control and monitoring of elevators, smoke control equipment, door hold-open devices, fire suppression systems, emergency power systems, and other equipment as indicated in the drawings and specifications.

1.02. ACCEPTABLE MANUFACTURERS

- A. Manufacturers: The equipment and service described in this specification are those supplied and supported by SimplexGrinnell and represent the base bid for the equipment.
 - 1. Subject to compliance with requirements, provide alternate products by one of the following:
 - a) SimplexGrinnell
 - b) Edwards Systems Technology
 - c) Pyrotronics
 - d) Silent Knight
 - e) Notifier
- B. Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.
- C. The Manufacturer shall be a nationally recognized company specializing in fire alarm and detection systems. This organization shall employ factory trained and NICET certified technicians, and shall maintain a service organization within 100 miles of this project location. The Manufacturer and service organization shall have a minimum of 10 years experience in the fire protective signaling systems industry.

1.03. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:
 - 1. Division 16: "Basic Electrical Materials and Methods."
 - 2. Division 16: "Conduit and Conductors"
 - 3. Division 15: "Fire Protection"
 - 4. Division 15: "HVAC Systems"

- C. The system and all associated operations shall be in accordance with the following:
 - 1. NFPA 72, National Fire Alarm Code
 - 2. NFPA 70, National Electrical Code
 - 3. NFPA 101, Life Safety Code
 - 4. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems
 - 5. Other applicable NFPA standards
 - 6. Local Jurisdictional Adopted Codes and Standards
 - 7. ADA Accessibility Guidelines

1.04. SYSTEM DESCRIPTION

- A. General: Provide a complete, non-coded, addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.
- B. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of 100% on-site programming to accommodate system expansion and facilitate changes in operation. All programming shall be capable of being accomplished via the front panel and via a lap top computer. All software operations shall be stored in a non-volatile programmable memory within the FACP. Loss of primary and secondary power shall not erase the instructions stored in memory.
- C. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. Separate alarm, supervisory and trouble logs shall be provided.
- D. Recording of Events: Record all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout differentiates alarm signals from all other printed indications.
- E. Wiring/Signal Transmission:
 - 1. Transmission shall be addressable signal transmission, dedicated to fire alarm service only.
 - 2. System connections for initiating (signaling) circuits and notification appliance circuits shall be Class A.
 - 3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.
- F. Remote Access:
 - 1. FACP shall have the capability to provide Remote Access through a Dial-Up Service Modem using the public switched telephone system of a private switched telephone system.
 - 2. A personal computer or technician's laptop, configured with terminal emulation software shall have the ability to access the FACP for diagnostics, maintenance reporting and information gathering.
- G. Required Functions: The following are required system functions and operating features:
 - 1. Priority of Signals: Alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Supervisory and Trouble events have second-, and third-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.

2. Noninterfering: The activation of an addressable device does not prevent the receipt of signals from subsequent activations.
3. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service transmitter provided under another contract.
4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and any required remote annunciators, indicating the location and type of device.
5. General Alarm: A system general alarm shall include:
 - a) Indication of alarm condition at the FACP and any required remote annunciator(s).
 - b) Identification of the device that is the source of the alarm at the FACP and any required remote annunciator(s).
 - c) Operation of audible and visible notification appliances throughout the building until silenced at FACP. Audible Alarm Notification shall operate Temporal Code.
 - d) Closing doors normally held open by magnetic door holders.
 - e) Unlocking designated doors.
 - f) Shutting down supply and return fans serving zone where alarm is initiated.
 - g) Closing smoke dampers on system serving zone where alarm is initiated.
 - h) Notifying the local fire department.
 - i) Initiation of elevator recall in accordance with ASME/ANSI A17.1, when specified sensors are activated.
6. Supervisory Operations: Upon activation of a supervisory device such as fire pump power failure, low air pressure switch, and tamper switch, the system shall operate as follows:
 - a) Activate the system supervisory service audible signal and illuminate the LED at the FACP and the graphic annunciator.
 - b) Pressing the Supervisory Acknowledge key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
 - c) Record the event in the FACP historical log.
 - d) Transmission of supervisory signal to remote central station.
7. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.
8. System Reset
 - a) The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-arming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."
 - b) Should an alarm condition continue, the system will remain in an alarmed state.
9. Drill: A manual evacuation (drill) switch shall be provided to initiate an alarm on the

FACP.

10. Manual Control: Manual controls shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble. The "off normal" status shall be clearly identified in plain-language on the FACP alphanumeric display.
 - a) Manual Bypass Control: The ability to perform a manual bypass of selected automatic functions shall be provided.
 - b) Circuit Enable/Disable Control: The system shall have provisions for disabling and enabling each circuit individually for maintenance or testing purposes.
11. WALKTEST: The system shall have a one person test feature. Enabling the one person test feature at the FACP shall activate the "One Person Testing" mode of the system as follows:
 - a) The city circuit connection and suppression release circuits shall be bypassed for the testing group.
 - b) Control relay functions associated to the testing group shall be bypassed.
 - c) The FACP shall indicate a trouble condition.
 - d) The alarm activation of any initiation device in the testing group shall cause the audible notification appliances to sound a code to identify the device.
 - e) The control panel shall automatically reset itself after signaling is complete.
 - f) Any momentary opening of an initiating or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.

H. Analog Smoke Sensors:

1. Monitoring: FACP shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The FACP shall determine the condition of each sensor by comparing the sensor value to the stored values.
2. Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.
3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 8 sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.
4. Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be viewed on a Maintenance Terminal CRT Display or printed for annual recording and logging of the calibration maintenance schedule.
5. Peak Value Logging: The FACP shall log the Peak Value of smoke obscuration or degree of temperature for each individual sensor to allow system calibration for maximum response time performance without nuisance alarms based on "actual ambient conditions".
6. The FACP shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to indicate that a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of

reporting are provided. The first level shall indicate that a sensor is close to a trouble reporting condition and will be indicated on the FACP as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a dirty sensor without creating a trouble in the system. If this indicator is ignored, a second level "DIRTY SENSOR" condition shall be indicated at the FACP.. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control panel.

7. The FACP shall continuously perform an automatic self-test on each sensor which will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.

I. Fire Suppression Monitoring:

1. Water flow: Activation of a water flow switch shall initiate general alarm operations.
2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.
3. WSO: Water flow switch and sprinkler valve tamper switch shall be capable of existing on the same initiating zone. Activation of either device shall distinctly report which device is in alarm on the initiating zone.

J. Audible Alarm Notification: By horns in areas as indicated on drawings.

K. Power Requirements

1. The control panel shall receive AC power via a dedicated fused disconnect circuit.
2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control panel.
4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.
5. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be indicated at the control panel.
6. The system shall support 100% of addressable devices in alarm operated at the same time, under both primary(AC) and secondary (battery) power conditions.
7. Loss of primary power shall sound a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.

1.05. SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

1. Product data sheets for system components highlighted to indicate the specific

products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

2. Wiring diagrams from manufacturer.
 3. Shop drawings showing system details including location of FACP, all devices, circuiting and details of graphic annunciator.
 4. System Power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per all applicable standards.
 5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of SLC, NAC, RAC, Sensor, and auxiliary control circuits.
 6. Operating instructions for FACP.
 7. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
 8. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
 9. Record of field tests of system.
- B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions if required to make clarifications or revisions to obtain approval.

1.06. QUALITY ASSURANCE

- A. Installer Qualifications: A factory authorized installer is to perform the work of this section.
- B. Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "UL" label.

1.07. MAINTENANCE SERVICE

- A. Maintenance Service Contract: Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives.
- B. Basic Services: Systematic, routine maintenance visits on a semi-annual basis at times scheduled with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.
- C. Additional Services: Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.
- D. Renewal of Maintenance Service Contract: No later than 60 days prior to the expiration of

the maintenance services contract, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. Owner will be under no obligation to accept maintenance service contract renewal proposal.

1.08. EXTRA MATERIALS

- A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:
 - 1. Break Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.
 - 2. Strobe Units: Furnish quantity equal to 10 percent of the number of units installed, but not less than one.
 - 3. Smoke Sensors, Fire Detectors, and Flame Detectors: Furnish quantity equal to 10 percent of the number of units of each type installed but not less than one of each type.
 - 4. Sensor Bases: Furnish quantity equal to 2 percent of the number of units of each type installed but not less than one of each type.

PART 2 – PRODUCTS

2.01. FIRE ALARM CONTROL PANEL (FACP)

- A. General: Comply with UL 864, "Control Panels for Fire-Protective Signaling Systems."
- B. The following FACP hardware shall be provided:
 - 1. Power Limited base panel with red cabinet and door, 120/277 VAC, 60 HZ input power.
 - 2. 250 Addressable point capacity inclusive of inputs and outputs in any combination.
 - 3. Maximum of 144 points of annunciation where one (1) point of annunciation equals:
 - a) 1 LED output or 1 switch input on a 24 Point I/O module.
 - 4. Four (4) Class B/Style Y Notification Appliance Circuits (NAC; rated 2A @ 24VDC, resistive);
 - 5. Two form "C" Auxiliary Output Circuits (rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory or other selective control operations. Provide capability for switching up to ½ A @ 120VAC, inductive loads.
 - 6. Dual Municipal City Circuit Connection for connection to either 24VDC Remote Station (reverse polarity) or local energy.
 - 7. The FACP shall support two (2) RS-232-C ports.
 - 8. Supervised serial communication channel for control and monitoring of remotely located LCD annunciators and I/O panels.
 - 9. Modular Network Communications Card.
 - 10. Common Event DACT.
- C. Cabinet: Lockable steel enclosure. Arrange panel so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single panel is required to form a complete control panel, provide exactly matching modular panel enclosures.
- D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD

display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.

2.02. REMOTE MAINTENANCE TERMINAL (CRT) AND PRINTERS

- A. Fire Alarm Control Panel shall be capable of operating a remote maintenance terminal and/or printers; output shall be ASCII from an RS-232-C connection with an adjustable baud rate.
- B. The FACP shall be capable of supporting and supervising as many as two (2) printers, or (1) maintenance terminal and (1) printer.

2.03. REMOTE LCD ANNUNCIATOR

- A. Provide Remote LCD Annunciator(s) as required with the same "look and feel" as the FACP operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys, Status LEDs and LCD Display as the FACP.
- B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with three (3) programmable LEDs (two selectable as red or yellow; one selectable as green or yellow).
- C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.
- D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- E. The LCD shall display the following information relative to the abnormal condition of a point in the system:
 - 1. 40 character custom location label.
 - 2. Type of device (e.g., smoke, pull station, waterflow).
 - 3. Point status (e.g., alarm, trouble).
- F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

2.04. EMERGENCY POWER SUPPLY

- A. General: Components include battery, charger, and an automatic transfer switch.
- B. Battery: Sealed lead-acid type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all notification appliances in alarm or supervisory mode for a period of 15 minutes.

2.05. ADDRESSABLE MANUAL PULL STATIONS

- A. Description: Addressable single- or double-action type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.
- B. Protective Shield: Where shown on the plans provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The

horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.

2.06. SMOKE SENSORS

- A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
 - 1. Factory Nameplate: Serial number and type identification.
 - 2. Operating Voltage: 24 VDC, nominal.
 - 3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
 - 4. Each sensor base shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.
 - 5. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
 - 6. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
 - 7. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
 - 8. Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.
 - 9. Removal of the sensor head for cleaning shall not require the setting of addresses.
- B. Type: Smoke sensors shall be of the photoelectric or combination photoelectric / heat type. Where acceptable per manufacturer specifications, ionization type sensors may be used.
- C. Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.
- D. Duct Smoke Sensor: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.
 - 1. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
 - 2. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.
 - 3. Duct Housing shall provide a relay control trouble indicator Yellow LED.
 - 4. Compact Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.

5. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
6. Duct Housing shall provide a magnetic test area and Red sensor status LED.
7. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
8. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch.
9. A NEMA 4X weatherproof duct housing enclosure shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

2.07. HEAT SENSORS

- A. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.
- B. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.
- C. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and] programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.
- D. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

2.08. ADDRESSABLE CIRCUIT INTERFACE MODULES

- A. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of evacuation indicating appliances and AHU systems.
- B. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line or a separate two wire pair running from an appropriate power supply as required.
- C. There shall be the following types of modules:
 1. Type 1: Monitor Circuit Interface Module:
 - a) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.
 - b) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.
 2. Type 2: Line Powered Monitor Circuit Interface Module
 - a) This type of module is an individually addressable module that has both

its power and its communications supplied by the two wire multiplexing signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.

- b) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.

3. Type 3: Line Powered Control Circuit Interface Module

- a) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

- D. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

2.09. ALARM NOTIFICATION APPLIANCES

- A. Notification Appliances: The Contractor shall furnish and install Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).
- B. Horn: Horn shall be listed to UL 464. The horn shall have a minimum sound pressure level of 83 or 89 dBA @ 24VDC. The horn shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings.
- C. Visible/Only (V/O): Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
- D. Audible/Visible (A/V): A/V Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 83 or 89 dBA @ 24VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings.
- E. Accessories: The contractor shall furnish the necessary accessories.

PART 3 – EXECUTION

3.01. INSTALLATION, GENERAL

- A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.

- B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:
 - 1. Factory trained and certified personnel.
 - 2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
 - 3. Personnel licensed or certified by state or local authority.

3.02. EQUIPMENT INSTALLATION

- A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.
- B. Existing Fire Alarm Equipment shall be maintained fully operational until the new equipment has been tested and accepted.
- C. Equipment Removal: After acceptance of the new fire alarm system, disconnect and remove the existing fire alarm equipment and restore damaged surfaces. Package operational fire alarm and detection equipment that has been removed and deliver to the Owner. Remove from the site and legally dispose of the remainder of the existing material.
- D. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.
- E. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

3.03. WIRING INSTALLATION

- A. Conduit: Install all fire alarm system wiring in conduit. Power-Limited Fire Alarm circuits may be installed in the same raceway as other power-limited signal circuits as allowed by article 725 of the National Electrical Code.
- B. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction (AH) and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).
- C. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.
- D. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

3.04. FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

- B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
 - 1. Factory trained and certified.
 - 2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
 - 3. International Municipal Signal Association (IMSA) fire alarm certified.
 - 4. Certified by a state or local authority.
 - 5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.
- C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.
- D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.
- E. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72.
- F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
- G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log.
- H. Final Test, Certificate of Completion, and Certificate of Occupancy:
 - 1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy.

3.05. CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.
- B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.06. TRAINING

- A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.
 - 1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.
 - 2. Schedule training with the Owner at least seven days in advance.

END OF SECTION

SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Clearing, grubbing, removal and disposal of vegetation, rocks, roots and debris within the limits of the work except objects designated on the drawings to remain.
- B. Preserve from injury or defacement all vegetation and objects to remain.

1.02 RELATED WORK

- A. Section 02 41 16: Demolition
- B. Section 31 22 13: Site Excavation
- C. Section 31 23 40: Backfilling and Finish Grading

1.03 LIMITS OF WORK

- A. Construction area established by drawings.
- B. Approved borrow pit areas.
- C. Designated stockpiles of construction material other than borrow material.

1.04 PROTECTION

- A. Protect living trees not marked for removal and outside the construction area. Treat cut or scarred surfaces of trees or shrubs with a paint prepared especially for tree surgery.
 - 1. Trees shall be protected by fencing to be located around the entire perimeter of the tree at the approximate dripline location.
 - 2. Shrubs and bushes shall be protected by fences or barricades.
 - 3. Shallow-rooted plants shall be protected at ground surface under and in some cases outside the spread of branches by ground cover protection consisting of 6-inch additional soil or crushed rock to be removed at completion of project.
- B. Protect benchmarks and existing structures, roads, sidewalks, paving and curbs against damage from vehicular or foot traffic.
- C. Maintain designated temporary roadways, walkways and detours, for vehicular and pedestrian traffic.

PART 2 PRODUCTS

- A. Fence shall be plywood or dimension lumber; suitable salvaged materials are acceptable.
- B. Wound paint shall be a standard bituminous product.
- C. Barricades shall be in accordance with local governing authority.

PART 3 EXECUTION

3.01 PREPARATION

- A. Maintain benchmarks, monuments and other reference points. Re-establish if disturbed or destroyed at no cost to Owner.

3.02 CLEARING AND GRUBBING

- A. Clear and grub areas required for access to site and execution of the work. Remove all stumps, roots within limits of grubbing to the depths below.
 - 1. Footings - 18 inches.
 - 2. Walks - 12 inches.
 - 3. Roads - 18 inches.
 - 4. Parking areas - 12 inches.
 - 5. Lawn areas - 8 inches.

6. Fills - 12 inches.
 7. In the case of footings, roads, walks, or other construction on fills, the greater depth shall apply.
- B. Remove low hanging, unsound or unsightly branches on trees or shrubs designated to remain.
 - C. Trim approximately ten feet.
 - D. Grub borrow pit and stockpile areas of all objectionable material. Strip overburden before placing material in stockpile areas.
 - E. Perform clearing and grubbing well in advance of construction or material removal activities.

3.03 PRUNING

- A. If trees, shrubs and other perennial growth are damaged in the course of Work of this Contract, prune damaged branches back to the first health (i.e., the nearest undamaged forks in branches or to the trunk) in accordance with standard practices of the industry.
 1. Where branches are cut back to the trunks, completely remove branches so there is no stub to become infected, and so that bark can heal itself over the cut.
 2. "Head-Back" cuts (cuts at right angles to the line of growth) of branches away from a fork will not be permitted.
- B. Paint wounds over 1 inch in diameter.

3.04 DEBRIS REMOVAL

- A. Promptly remove cleared debris from site.
- B. Obtain permission from applicable regulatory authority for disposal of debris to waste disposal site.
- C. Do not burn or bury materials on site.

3.05 REPAIRS

- A. Should utilities to remain or other physical property be damaged by work of this Section, repair damage.
- B. Backfill all excavations opened as a result of the work of this Section with the type of fill specified in Section 31 23 40 for the individual locations.

END OF SECTION

SECTION 31 22 13
SITE EXCAVATION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Excavating and grading for:
 - 1. Roadways & Parking areas.
 - 2. Building pads.
 - 3. Embankment areas.
 - 4. Waterways and ditches (including inlet structures and outlet ditches, channels, waterways, etc.)
- B. Excavating of unsuitable material from beneath structured areas and fill embankment areas.

1.02 RELATED WORK

- A. Division One: Testing Laboratory Services
- B. Section 22 14 00: Storm Drainage Systems
- C. Section 31 11 00: Clearing and Grubbing
- D. Section 31 23 35: Excavating and Backfilling for Service Utilities
- E. Section 31 23 40: Backfilling and Finish Grading
- F. Section 31 71 15: Proof Rolling

1.03 QUALITY ASSURANCE

- A. Testing Laboratory and Soils Engineer:
 - 1. The Soils Engineer and Testing Laboratory's fees will be paid by the Owner except when the Soils Engineer or Testing Laboratory personnel are notified by the Contractor that work will be in progress, and they (Soils Engineer or Laboratory personnel) come to job site and work is not in progress. In that case, the Contractor shall pay for Soils Engineer's or laboratory personnel's time and mileage. Contractor shall pay for retesting as required.
 - 2. Have earth borrow fill and structural fill tested and approved by designated testing laboratory before moving it to the job site.
 - 3. Areas where building and paved areas will be located shall be proof-rolled to determine adequacy of soils compaction. Other areas will be inspected by Soils Engineer to determine adequacy in other areas.
 - 4. Soils compaction testing of in-place soil, and filling compacted areas will be performed by Testing Laboratory in accordance with their requirements.
 - 5. Verify quantities of materials where unit prices are involved.

1.04 EXISTING CONDITIONS

- A. Known underground, surface and aerial utility lines, and buried objects are indicated on the Drawings.
- B. Do not interrupt existing utilities service to facilities occupied and used by the Owner or others, except when permitted in writing, by Owner's Representative and then only after temporary utility services have been provided.

1.05 PROTECTION

- A. Protect trees, shrubs and lawns, rock outcroppings and other features remaining as part of final landscaping.
- B. Protect benchmarks, existing structures, fences, roads, sidewalks, paving and curbs against damage from equipment and vehicular traffic.
- C. Protect aerial, surface, or underground utility lines and appurtenances which are to remain.
- D. Repair damage.
- E. Erosion control must be maintained. Refer to notes on General Note's sheet and Erosion and Sediment Control Details plan.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Provide for surface drainage during the period of construction in a manner to avoid creating a nuisance to adjacent areas. Keep excavations free of water during the entire progress of the work, regardless of the case, source, or nature of the water. Refer to the geotechnical report for details regarding the sensitivity of existing soils to moisture.
- B. Trees shall be left undisturbed, insofar as possible, as shown on drawings.

1.07 SEDIMENT AND EROSION CONTROL

- A. Install all erosion control measures prior to beginning site grading operations.
- B. Protect newly graded areas from erosion. Where necessary, temporarily seed disturbed areas with Bahia or annual rye grass at a rate of 4 lbs/1000 sq. Ft. If seeding is necessary in summer months, contact the Owner's Representative for an approved seeding application.
- C. Repair settlement and erosion which occurs prior to acceptance of work.
- D. Temporary Ditch Checks: Place two unbroken straw bales in a "V" formation, with open end upstream in ditches as directed by Owner's Representative. Place ditch check at 50 foot intervals for ditches, with slopes between 1.0 percent and 3.0 percent. For ditches steeper than 3.0 percent, place at 25 foot intervals and stake each bale firmly with a 2" x 4" wood stake or other means as directed by the Owner's Representative.
- E. Leave straw bale ditch checks in place throughout construction except when ditches are fine graded, and seeded or sodded.
- F. Perform periodic maintenance on ditch checks to remove sediment and replace straw bales as necessary so as not to inhibit flow or runoff.

1.08 REFERENCE STANDARDS

- A. Determine soil's maximum dry density and optimum moisture in accordance with ASTM D698.
- B. Soil and rock borings or soundings, if provided, are:
 - 1. For information purposes only.
 - 2. No guarantee of existing conditions.
 - 3. No substitute for investigations deemed necessary by Contractor.

PART 2 PRODUCTS

2.01 Materials

- A. Topsoil: Excavated materials, graded free of roots, subsoil, debris, large weeds, toxic substances, and rocks greater than 1 inch.

PART 3 EXECUTION

3.01 PREPARATION

- A. Establish and identify required lines, levels, contours and datum.
- B. Maintain benchmarks, monuments, and other reference points. Reestablish if disturbed or destroyed, at no cost to Owner.
- C. Before start of grading, establish the location and extent of utilities in the work areas. Notify utilities to remove and relocate lines which are in the way of construction.
- D. Maintain, protect, reroute or extend as required existing utilities to remain which pass through the work area.
- E. Upon discovery of unknown utility or concealed conditions, discontinue affected work and notify the Architect.

3.02 REMOVAL OF TOPSOIL

- A. Remove topsoil of horticultural value from areas to be excavated and regraded, and stockpile in designated area.
- B. Do not permit topsoil to be mixed with subsoil.
- C. Do not strip topsoil when wet.

3.03 GENERAL SITE EXCAVATION

- A. Do not excavate wet subsoil materials.
- B. Excavate subsoil required to allow placement of compacted backfill under paving and site structures, and to accommodate construction operations.
- C. Machine slope banks to angle of repose or less until shored.
- D. Removed lumped subsoil, boulders and rock.
- E. Completely remove stumps, roots over 1 inch in diameter, and similar on-grade and below-grade obstructions within the area to be covered by new construction and for a distance of 10 feet beyond area in all directions. In other areas disturbed by grading, remove such obstructions to a depth of 2 feet below subgrade.
- F. Correct unauthorized excavation, including areas over-excavated by error, at no extra cost to the Owner.
- G. Stockpile excavated material in designated area on site to a depth not exceeding 8 feet and protect from erosion. Remove excess material not being reused from site. Stockpile areas are to be identified during a pre-construction meeting of the jobsite.
- H. If existing basements, cellars, cisterns, wells, septic tanks, drain fields, cesspools, catch basins, sink holes, manholes and similar items are encountered, remove to solid subgrade and break up masonry and/or concrete bottoms so that no pieces remain over 12 inches in their longest dimension.

3.04 PREPARATION OF NATURAL GROUND

- A. Proof-Roll in accordance with section 31 71 15. Owner's Representative is to identify any unstable areas.
- B. Unsuitable subgrades identified by the Owner's testing agency shall be undercut and replaced with properly compacted fill as noted in remedial work.
- C. Subgrade soils shall be scarified and compacted to at least 95% of the standard proctor maximum dry density (ASTM D698) for a depth of at least 8" below the surface.

3.05 REMEDIAL WORK

- A. Any exposed subgrades determined by the Owner's testing agency as being unsuitable shall be undercut to a depth identified by the testing agency and backfilled under the appropriate provisions of Section 31 23 35 for the location.
 - 1. Notify the Architect to obtain approval prior to beginning undercutting operations.
 - 2. Keep records of material quantities removed and replace as specified in Division 1 and have materials verified by the Owner's testing agency.
- B. Excavate shallow temporary drainage ditches to facilitate removal of excess moisture from subgrade areas.
- C. Backfill and compaction of areas excavated under this Section is specified in Section 31 23 35.

3.06 CLEAN-UP AND DISPOSAL OF DEBRIS

- A. Remove surplus materials and debris from site.

END OF SECTION

SECTION 31 23 35
EXCAVATING AND BACKFILLING FOR SERVICE UTILITIES

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Excavation for piped utility material.
- B. Provide necessary sheeting, shoring and bracing.
- C. Prepare trench bottom with appropriate materials.
- D. Dewater excavation as required.
- E. Place and compact granular beds, as required, and backfill.

1.02 RELATED WORK

- A. Division One: Testing Laboratory Services
- B. Division One: Project Close Out
- C. Section 22 14 00: Storm Drainage Systems
- D. Section 31 11 00: Clearing and Grubbing
- E. Section 31 22 13: Site Excavation
- F. Section 31 23 40: Backfilling and Finish Grading
- G. Section 32 12 16: Asphaltic Concrete Paving
- H. Section 33 11 20: Domestic Water & Fire Services
- I. Section 33 30 00: Sanitary Sewage Systems

1.03 TESTS

- A. Test and analysis of fill materials will be performed to determine compaction of trench backfill in accordance with ASTM D698 and under provisions of Division 1 of the Specifications.
 - 1. Have aggregate tested prior to moving material to the job site.

1.04 PROTECTION

- A. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.
- B. Underpin adjacent structures which may be damaged by excavation work, including service utilities and pipe chases.
- C. Notify the Architect of unexpected subsurface conditions and discontinue work in affected area until notification to resume work.
- D. Provide surface drainage to keep excavations free of water. Grade the top perimeter of excavations to prevent surface water run-off into excavations. Pump if required.
- E. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
- F. Protect Public utilities at project site property lines to prevent damage.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of the local department of public works.

1.06 COORDINATION

- A. Schedule trench excavations so that those pipes passing under foundations are in place and trenches are properly backfilled before foundations are placed.
- B. Coordinate with other trades affected by this work.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Pipe and structure bedding:
 - 1. Coarse aggregate: ASTM D448 Size No 57, pit run or natural crushed stone or gravel, free from shale, clay, friable material and debris.
 - 2. Fine aggregate: Clean, natural or manufactured sand, washed, free of silt, loam, friable or soluble materials, and organic matter, with no more than 15% finer than a No. 200 sieve.
- B. Trench and pit backfill:
 - 1. Engineered fill material specified in Section 31 23 40, for areas outside of building and pavement areas.
 - 2. Granular backfill for structural loaded areas.

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum under provisions of the Division 1 of the Specifications.

3.02 EXCAVATION

- A. General:
 - 1. Make excavations sufficiently wide to enable installation of utilities and allow inspection. Hand trim excavation and leave free of loose matter.
 - 2. Remove lumped subsoil, boulders, and rock.
 - 3. Depths: Unless otherwise indicated, excavate to a depth which will allow placement of pipes below frost line, but in no case less than 2 feet below finished grade.
 - 4. When excavation is in rock, over excavate at least 6 inches and backfill with sand for bedding.
 - 5. Do not allow excavation to interfere with normal 45o bearing splay of foundations.
 - 6. Correct unauthorized excavation at no cost to the Owner. Fill over-excavated areas under pipe bearing surfaces in accordance with direction by the Architect.
 - 7. Provide separate trenches for water lines and sewer lines. Provide separation specified in individual utility Sections.
 - 8. Stockpile excavated material in an area designated on the site. Keep material separate from materials stockpiled for reuse as backfill for structures and lawn areas. Remove excess materials from the site.
 - 9. Do not allow any pipe to be laid in wet, muddy or frozen trenches.
- B. Trenches:
 - 1. Bell and spigot type piping:
 - a. Excavate trenches wide enough to allow for proper jointing, bedding and visual inspection of at least the top half of each side of pipe.
 - b. Excavate to a depth below fill aggregate so that tops of all piping is at least one foot below bottoms of concrete slabs.
 - c. Sewer and drain lines: Unless otherwise indicated, establish uniform rates lines will have a drop of 1/4 inch per foot inside of the building, and 1/8 inch per foot outside of the building.
 - d. Excavate so that bottom is uniformly smooth, and with bell holes scooped out so that the barrel of each length of pipe is fully supported.
 - 2. Copper pipe, PVC pipe and electrical conduit:
 - a. Excavate to a depth below fill aggregate, or furrow out fill aggregate, as applicable, so that tops of all runs are at least 6 inches below bottoms of concrete slabs after bedding is accomplished.
 - b. In earth fill below aggregate, excavate to a depth of at least 6 inches below bottoms of runs in final position and backfill with sand. Tamp sand to settle it and provide a smooth surface to uniformly support runs.

- c. In furrowed out fill aggregate, line trenches with a layer of roofing felt. Place at least 3 inches of sand on top of felt and tamp it smooth.
 - d. Trenches may be narrow provided materials to be installed can be properly bedded, connected and inspected.
- C. Pit Excavation:
 - 1. Excavate pits for items such as, but not limited to, manholes, catch basins, and grease traps to depths required for proper installation of items.
 - 2. Make bottoms smooth and level.
 - 3. Over excavate sides of pit enough to provide space for construction of forms or masonry work, as required, for proper installation and inspection.

3.03 INSPECTION

- A. Verify that stockpiled fill is approved.
- B. Verify that adjacent construction is braced to support surcharge forces imposed by backfilling operations.
- C. Verify areas to be backfilled are free of debris, snow, ice or water, and that ground surfaces are not frozen.

3.04 BACKFILLING

- A. General:
 - 1. Do not backfill until lines are installed, tested, and approved.
 - 2. Support pipe and conduit during placement and compaction of bedding fill.
 - 3. Backfill to contours and elevations. Backfill systematically, as early as possible, to allow maximum time for settlement. Do not backfill over porous, wet or spongy surfaces.
 - 4. Place and compact fill materials in continuous layers not exceeding 6 inches in loose depth.
 - 5. Maintain optimum moisture content of backfill materials to attain required compaction density.
 - 6. Remove surplus backfill materials from the site.
 - 7. Leave stockpile areas completely free of excess fill materials.
- B. Backfilling pipe 4 inches in diameter and larger:
 - 1. Bed pipe a minimum depth of 6 inches and extend pipe springline. Place bedding to uniformly support pipe along the entire length and tamp to a dense condition.
 - 2. Backfill with approved materials to level of adjacent grades by placing in 6-inch maximum lifts and compacting each lift as specified herein.
- C. Backfilling pipe less than 4 inches in diameter:
 - 1. Bed pipe a minimum depth of 3 inches and extend to one foot above top of pipe. Place bedding to uniformly support pipe along the entire length and tamp to a dense condition.
 - 2. Backfill with approved materials to level of adjacent grades by placing in 6-inch maximum lifts and compacting each lift as specified herein.
- D. Backfilling pits:
 - 1. Do not backfill pits until items have been completed and tested.
 - 2. Concrete, masonry and cast iron items: Backfill with coarse aggregate. Place aggregate in one-foot layers and compact each layer after it is placed.
 - 3. Where items are placed in lawn areas, fill aggregate to within 2 ft. Of finished grade, and finish backfilling to grade with earth fill. Tamp and compact earth fill to the same density as adjacent grade materials.
 - 4. Where items are placed in areas covered by paving or other hard surfaced construction, fill with coarse aggregate to bottom of base course.

3.05 TOLERANCES

- A. Top surfaces of backfilling: 1 inch.

3.06 COMPACTION

- A. Structural areas (outside of building pad): Compact to 95% of the proctor density specified above. The upper 18" of the backfill shall be compacted to 98% of ASTM D698.
- B. Lawn and landscape areas: Compact to 90% of the proctor density specified above.

3.07 CLEAN-UP

- A. After work of this Section is completed, leave areas clean and free from debris.
- B. After backfill is complete, remove excess earth fill material and spread on the job site in a designated area. Excess aggregate fill shall be removed from the job site and disposed of in accordance with local regulations.

END OF SECTION

SECTION 31 23 40
BACKFILLING AND FINISH GRADING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Finish grade sub-soil.
- B. Cut out areas to receive stabilizing base course materials for paving and sidewalks.
- C. Place, finish grade and compact topsoil.

1.02 RELATED WORK

- A. Division One: Testing Laboratory Services
- B. Section 31 11 00: Clearing and Grubbing
- C. Section 31 22 13: Site Excavation
- D. Section 31 23 20: Excavation and Backfill for Structures
- E. Section 31 23 35: Excavating and Backfilling for Service Utilities
- F. Section 31 71 15: Proof-Rolling
- G. Section 32 92 23: Sodding

1.03 PROTECTION

- A. Prevent damage to existing trees to remain, bench marks, pavement, and utility lines. Correct damage at no cost to the Owner.

1.04 QUALITY ASSURANCE

- A. Owner will employ a qualified testing laboratory to observe this work and make tests required. Testing Lab will:
 - 1. Have borrow fill, aggregate, sand and topsoil tested and approved before it is moved to the project site.
 - 2. Observe proof-rolling of site to determine adequacy of in-place soils. If soils are not adequate to bear weights which will be imposed, Testing Lab will direct corrective action to be taken.
 - 3. Test in-place soil and filled and compacted areas. If these are not adequate to bear weights imposed, Testing Lab will advise the Structural Engineer of his recommendations. He will direct any corrective measures that are necessary.
 - 4. Verify quantities of material removed and quantities of material placed, where Unit Prices are involved.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. Refer to the geotechnical engineering report for suitability of on-site soil material to be used as engineered fill for final site grading. The material shall be observed and tested by the on-site geotechnical testing firm to determine it's suitability as fill beneath pavement areas.
- B. Refer to the specifications for fill beneath building areas.

PART 3 EXECUTION

3.01 BACKFILLING

- A. Examination: Verify fill materials to be reused are acceptable under requirements of the Contract Documents.
- B. Preparation:

1. Proofroll subgrade prior to fill placement as specified in Section 31 71 15, and repair unstable subgrades prior to placement.
- C. Backfilling:
1. Backfill areas are to required elevations with unfrozen specified materials and compact to density equal to or greater than requirements specified below.
 2. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
 3. Place and compact materials in continuous layers not exceeding the following thickness in pre-compacted depth:
 - a. Granular fill: 8 inches.
 - b. Cohesive fill: 8 inches.
 4. Maintain soil at optimum moisture content of backfill materials for structurally loaded areas within a range of -2 to +2 percentage points above the optimum moisture content value to attain required compaction density.
- D. Slopes:
1. Minimum slope grade away from building minimum 0.2 feet in 10 feet unless indicated otherwise. Achieve a slope of 0.5 feet in 10 feet, wherever possible.
 2. Make grade changes gradual. Blend slope into level areas.
- E. Stockpile areas:
1. Remove surplus backfill materials from the site or dispose of on-site in a designated area.
 2. Leave areas completely free of excess materials.
- F. Field quality control:
1. Field inspection and testing will be performed as defined in Division 1 of the specifications.
 2. Test and analysis of fill materials will be in accordance with ASTM D698.
 3. Compaction testing will be performed in accordance with ASTM D1556 or other method recommended by the Owner's testing agency and acceptable to the Owner's Representative.
 4. If test indicates the work of this Section does not meet specified requirements, remove, replace and retest materials at no cost to the Owner.
 5. Proofroll compacted fill surfaces under slabs-on-grade and paving for a distance of 10 feet beyond slabs and paving in all directions under provisions of Section 31 71 15.

3.02 PROTECTION OF FINISHED WORK

- A. Recompact fills subjected to vehicular traffic.

3.03 SCHEDULE

- A. The paragraphs below identify location, fill material to be used (identified from lower to upper fill material), compacted thickness of each fill, and compaction expressed as a percentage of maximum density and optimum moisture in comparison with soil proctor specified above.
- B. Areas under building: Refer to Structural specifications for fill requirements beneath the building envelope.
- C. Seeded, sodded and landscaped areas: Engineered or earth fill to 6 inches below finish grade, compacted to 90%.
- D. Asphalt Paving: Engineered fill to 18" below bottom of base course compacted to 95%. Upper 18" of subgrade shall be compacted to 98%.
- E. Concrete paving: Engineered fill to 18" below bottom of base course compacted to 95%. Upper 18" of subgrade shall be compacted to 98%.
- F. Concrete walks and pads: Engineered fill to bottom of aggregate course, compacted to 95%.

3.04 PLACING TOPSOIL

- A. Place topsoil in areas where seeding, sodding, and planting is to be performed. Place to the following minimum depths, up to finished grade elevations:
1. 6 inches for seeded areas.

- 2. 6 inches for sodded areas.
- B. Use topsoil in relatively dry state. Place during dry weather.
- C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles and contours of sub-grades.
- D. Remove stone, roots, grass, weeds, debris and other foreign material while spreading.
- E. Manually spread topsoil around trees and plants to prevent damage which may be caused by grading equipment.
- F. Lightly compact placed topsoil.

3.05 CLEAN-UP

- A. Upon completion of work of this Section, clean up and leave area free of debris, excess material, and equipment.
- B. Any excess earth shall be disposed of on-site by the contractor in an area to be designated by the owner's representative.

END OF SECTION

SECTION 31 31 16
TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Chemical soil treatment.
- B. Site-applied termiticide for wood, steel, and concrete.

1.02 REFERENCE STANDARDS

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 1947 (Revised 2001).

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements.
- D. Test Reports: Indicate regulatory agency approval reports when required.
- E. Manufacturer's Certificate: Certify that toxicants meet or exceed specified requirements.
- F. Certificate of compliance from authority having jurisdiction indicating approval of toxicants.
- G. Manufacturer's Instructions: Indicate caution requirement.
- H. Record and document moisture content of soil before application.
- I. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three (3) years of documented experience.
- J. Maintenance Data: Indicate re-treatment schedule .
- K. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
 - 1. Having minimum of three (3) years documented experience.
 - 2. Approved by manufacturer of treatment materials.
 - 3. Licensed in Missouri.

1.05 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year installer's warranty against damage to building caused by termites.
 - 1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.
 - 2. Inspect annually and report in writing to Owner. Provide inspection service for two years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 CHEMICAL SOIL TREATMENT

- A. Toxicant Chemical: EPA (Title 7, United States Code, 136 through 136y) approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.
- C. Manufacturers:
 - 1. Bayer Environmental Science Corp: www.backedbybayer.com/pest-management/#sle.
 - 2. FMC Professional Solutions: www.fmcprosolutions.com/#sle.
 - 3. Syngenta Professional Products: www.syngentaprofessionalproducts.com/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.

D. Mixes: Mix toxicant to manufacturer's instructions.

2.02 SITE-APPLIED TERMITICIDE

A. Site Applied Termiticide for Wood, Steel and Concrete: Borate mineral salt based, spray applied termiticide formulated for use on wood, steel, concrete and other building materials.

1. Active Ingredient: 40% minimum disodium octaborate tetrahydrate (DOT).

2. Carrier and Penetrant: Proprietary glycol solution.

3. Products:

a. Nisus Corporation; Bora-Care: www.nisuscorp.com/#sle.

b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.

B. Verify final grading is complete.

3.02 APPLICATION - CHEMICAL TREATMENT

A. Comply with requirements of U.S. EPA and applicable state and local codes.

B. Spray apply toxicant in accordance with manufacturer's instructions.

C. Apply toxicant at following locations:

1. Under Slabs-on-Grade.

2. At Both Sides of Foundation Surface.

3. Soil Within 10 feet of Building Perimeter For a Depth of 5 feet.

D. Under slabs, apply toxicant immediately prior to installation of vapor barrier.

E. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations.

F. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.

G. Re-treat disturbed treated soil with same toxicant as original treatment.

H. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.03 INSTALLATION - SITE-APPLIED TERMITICIDE

A. Comply with manufacturer's written instructions.

3.04 PROTECTION

A. Do not permit soil grading over treated work.

B. Protect sheet materials from damage after completed installation. Repair damage with manufacturer's recommended products and according to the manufacturer's written instructions.

END OF SECTION

SECTION 31 71 15
PROOF-ROLLING

PART 1 GENERAL

1.01 RELATED WORK

- A. Section 31 05 50: Site Excavation
- B. Section 31 23 40: Backfilling and Finish Grading

1.02 QUALITY ASSURANCE

- A. The Owner will employ a testing agency to observe proof-rolling operations and make required test.
- B. Do not perform proof-rolling operations unless testing agency personnel are present.
- C. Neither proof-rolling operations or subsequent fill operations will be acceptable for payment unless testing agency personnel views proof-rolling.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Vehicle: Loaded rubber tired dump truck having a single axle weight of approximately 30,000 lbs, or similar equipment.

PART 3 EXECUTION

3.01 PROOF-ROLLING

- A. Areas to proof-roll:
 - 1. Areas to be covered by construction.
 - 2. Areas to be covered with fill.
 - 3. Lawn areas attained by excavation.
 - 4. Areas 10 feet beyond the above areas in all directions.
- B. Observation: Run Vehicle at normal walking speed so that the testing agency personnel may observe the ground at all times. Testing personnel will conduct additional test they deem necessary to determine existing conditions. Testing personnel will direct remedial actions they deem necessary.

3.02 REMEDIAL WORK

- A. Remedial work required by testing agency after viewing proof-rolling operations are specified in individual sections requiring proof-rolling.
- B. Provide Lime stabilization in accordance with the Missouri State Department of Highways and Public Transportation - latest Edition.

END OF SECTION

SECTION 32 05 23
SITE CONCRETE WORK

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Formwork complete with required shoring, bracing and anchorage.
- B. Concrete reinforcing, complete with required supports, spacers and related accessories.
- C. Cast-in-place concrete.
- D. Construction, expansion and contraction joints.

1.02 RELATED WORK

- A. Section 31 22 13: Site Excavation
- B. Section 31 23 40: Backfilling and Finish Grading
- C. Section 32 17 23: Pavement Marking
- D. Section 03 35 19 Dry Shake Colored Concrete Hardener

1.03 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301. Maintain one copy at the job site.
- B. Obtain materials from the same source throughout.
- C. Do not place concrete when base surface temperature is less than 40oF or forecast to go below 40o for 24 hours, and when surfaces are wet or frozen.

1.04 REGULATORY REQUIREMENTS

- A. Comply with local codes and ordinances for concrete work on public property.

1.05 TESTS

- A. Testing and analysis will be performed in accordance with practices specified elsewhere in the specifications.
- B. Submit the proposed mix design of each type of concrete at least two weeks prior to commencement of concrete work.
 - 1. Base material proportions on ACI procedures.
 - 2. Show type of materials, slump range, air content, aggregate gradation and 28 day compressive strength.
- C. The Owner's testing agency will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.
 - 1. Four test cylinders will be taken for every 75 (or less) cubic yards of concrete placed each day.
 - 2. One slump test and air entrainment test will be taken for each set of cylinders taken.
- D. Verify results of tests for compliance with the Contract Documents.

1.06 SUBMITTALS

- A. Submit product data on joint filler, admixtures and curing compounds including properties, chemical composition and installation instructions.
- B. Submit shop drawings showing sizes and locations of reinforcing, splicing details and other pertinent installation details.
- C. Submit certification that concrete materials comply with referenced standards.
- D. Use Materials and Resources Form to report materials' recycled content, local/regional content, and cost for MR Credits 4 & 5 per section 018113.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete materials:
 - 1. Cement: ASTM C150 Type I Portland cement, gray color.
 - 2. Aggregates: ASTM C33.
 - 3. Water: Clean and not detrimental to concrete.
- B. Form materials:
 - 1. Forms: Wood or steel form material profiled to suit conditions.
 - 2. Joint filler: ASTM D994 bituminous type, 1/2 inch thick.
 - 3. Form release agent: Colorless mineral oil which will not stain concrete or absorb moisture.
 - 4. Fillets for chamfered corners: Wood or plastic strips sized to make a 3/4 inch chamfered corner, maximum possible lengths.
- C. Reinforcement:
 - 1. Reinforcing steel: ASTM A615 Grade 60, deformed billet steel bars, uncoated finish.
 - 2. Welded wire fabric: ASTM A185 plain type in flat sheets, uncoated finish.
 - 3. Tie wire: Minimum 16 gauge annealed steel.
 - 4. Dowels: ASTM A615 Grade 40 plain steel, uncoated finish.
- D. Admixtures:
 - 1. Air entrainment: ASTM C260.
 - 2. Water reducing: ASTM C494 Type F high range.
 - 3. Accelerating: ASTM C494 Type C.
 - 4. Set-retarding: ASTM C494 Type B.
- E. Joint sealer: ASTM D1190 hot poured elastic type.
- F. Curing compound: ASTM C309, Type 1-D, Class 2, 30% solids.

2.02 CONCRETE MIX

- A. Mix concrete in accordance with ASTM C94.
 - 1. Air entrained to result in a 4 percent plus/minus 1 percent air.
 - 2. Maximum slump of 4 inches.
- B. Compressive strength:
 - 1. Sidewalks, pads, curbs and gutters: 3500 psi at 28 days.
 - 2. Vehicular pavements: 4000 psi at 28 days.
- C. Accelerating Admixtures: Use in cold weather only when approved by the Architect. Use of admixtures will not relax cold weather placement requirements.
- D. Set Retarding Admixtures
 - 1. Use set-retarding admixtures in hot weather only when approved by the Architect.
- E. Do not add calcium chloride to concrete.

PART 3 EXECUTION

3.01 PREPARATION OF BASE

- A. Verify that the supporting base is properly prepared and compacted, and true to line and grade.
- B. Moisten base to minimize absorption of water from fresh concrete.
- C. Notify the Architect a minimum of 24 hours prior to commencement of concreting operations.
- D. Frames of subsurface structures: Coat surfaces of new and existing frames with oil to prevent bonding with concrete.
- E. Notify the Owner's testing agency a minimum of 72 hours prior to commencement of concreting operations.

3.02 FORM WORK

- A. Form Setting:
 - 1. Place and secure forms to correct locations, dimensions and profiles.
 - 2. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
 - 3. Construct forms sufficiently tight to prevent mortar leakage. Lock form section to be free from ply or movement in any direction.
 - 4. Place joint fillers vertical in position, in straight lines. Secure to formwork during concrete placement.
 - 5. Provide chamfers at all exposed concrete edges.
 - 6. Apply form release agent to form surfaces in accordance with the manufacturer's printed instructions, before placing reinforcing and embedded items.
- B. Grade and Alignment:
 - 1. Check and correct the alignment and grade elevation of the forms immediately before placing the concrete.
 - 2. When any form has been disturbed or any grade has become unstable, reset and recheck the form.

3.03 REINFORCEMENT

- A. Ensure all reinforcing is clean, and free of rust, scale, oil, dirt or other materials which may reduce bonding.
- B. Have required bends made in the shop without heat.
- C. Place reinforcement in accordance with approved shop drawings.
- D. Interrupt reinforcement at expansion joints.
- E. Support reinforcing with precast concrete blocks, metal chairs or other method approved by the Architect. Supporting with gravel, brick or wood blocks is not permitted.

3.04 GENERAL CONCRETE PLACEMENT

- A. Place concrete in accordance with ACI 301. When central or transit mixed concrete is used, place the mixture where it will require as little rehandling as possible.
- B. Keep forms and subgrade moist during concrete placement.
- C. Ensure reinforcement, embedded items and formed joints are not disturbed during concrete placement.
- D. Do not allow concrete to free fall more than 3 feet.
- E. Distribute and spread concrete as soon as possible. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- F. Thoroughly work concrete with suitable tools to remove coarse aggregate from the surface and to place mortar against the form. Work concrete to produce a smooth finish, free of air pockets, water pockets and honeycombs.
- G. Consolidate concrete against and along the faces of all forms and along the full length and on both sides of all joint assemblies with a suitable mechanical vibrator. Do not permit the vibrator to come in contact with forms, joint assemblies or subgrade. Do not over vibrate concrete or use the vibrator to transport or flow concrete.
- H. Ensure positive drainage to all drains and away from all window sills and door openings, unless specifically noted otherwise.

3.05 PAVEMENTS

- A. Longitudinal lines: Sawed or preformed, 1-4 inch wide x 1-1/2 inch deep, at approximately 12 ft. o.c. with equal spacing between slabs and parallel to the direction of travel.
 - 1. Joint Face: Metal key-way type with metal or wood forms.
 - 2. Tie bars: 1/2 inch diameter bars at 48 inches o.c.
 - 3. Place joint sealant to a minimum depth of 1/2 inch with approved backer materials.

- B. Transverse contraction and construction joints: 3/8 inch wide x 1/2 inches deep, at approximately 12 ft. o.c. and perpendicular to the direction of travel.
 - 1. Joints may be saw-cut, formed by hand or premolded filler.
 - 2. Provide load transfer device consisting of 3/4 inch diameter smooth dowels at 12 inches o.c. Coat dowels with a thick film of heavy grease on one end. Minimum dowel embedment to be 6".
 - 3. Place joint sealant to a minimum depth of 1/2 inch with approved backer materials.
- C. Isolation Joints: Isolate objects abutting or adjacent to paved areas with premolded filler extended the full depth of the slab.
- D. Finishing:
 - 1. Finish concrete in the following sequence: Strike-off, consolidation, floating and removal of laitance.
 - 2. Provide light broom texture transverse to traffic flow direction.
 - 3. Round edges of each side of joints to an inch radius.
- E. Curing: Uniformly apply curing compound over the entire surface after finishing, initial set and removal of side forms, in accordance with the manufacturers printed instructions for the application.

3.06 CURBS AND GUTTERS

- A. Joints: Construct edges and joints as indicated.
 - 1. Expansion joints: Premolded joint filler at no more than 50 ft. o.c. Extend to within 1/4 inch of the surface.
 - 2. Contraction joints: Score joints at minimum spacing of 10 ft. o.c.
 - 3. Construct edges and joints as indicated.
- B. Provide for curb cuts, wheel chair ramps and drainage ways as indicated.
- C. Install premolded joint filler where curbs adjoin adjacent structures.
- D. Match existing curbs and curb and gutter sections flush.
- E. Hand work curbs as necessary to match drainage structures flush.
- F. Finishing: Finish with a light broom texture.
- G. Curing: Uniformly apply curing compound over the entire surface after finishing, initial set and removal of side forms, in accordance with the manufacturer's printed instructions for the applications.

3.07 WALKS

- A. Construct to general grade and spot elevations indicated. Wavy walks or walks that pond water are not acceptable.
- B. Construct with turned-down edges where indicated.
- C. Place short vertical curves where necessary and where change in grade exceeds 2%. Do not exceed 1/2 inch/ft. slope within 2 feet of top and bottom steps. Crown 1/4 inch/ft. or cross slope to maintain drainage.
- D. Joints:
 - 1. Install 1/2 inch premolded joint filler at no more than 25 feet o.c., at walk junctions and intersections, at top and bottom of steps, and where walks abut curbs, building, slabs or other fixed objects. Extend to within 1/4 inch of the surface.
 - 2. Install expansion joints in irregular walk sections at right angles to the walk centerline to create panels not exceeding 250 sq ft. Extend the full depth of the slab.
 - 3. Score joints at minimum spacing of 5 ft. o.c. With a suitable edging tool.
- E. Finishing:
 - 1. Slopes exceeding 5%: Finish with a bolted or heavy broom texture.
 - 2. Other surfaces: Finish with a light broom texture.
 - 3. Round edges, including each side of joints and grooves, to a 1/4 inch radius.

- 4. Finish walks to be 1/4 inch above curb, and with a neat bevel at termination with curbs.
- F. Curing: Uniformly apply curing compound over the entire surface after finishing, initial set and removal of side forms, in accordance with the manufacturer's printed instructions for the application.
- G. Protection: Do not remove forms until at least 24 hours after paving. Protect walks from pedestrian traffic and applied loads for at least three days after paving.

3.08 DUMPSTER PAD

- A. Install pad in accordance with the general and spot elevations indicated. Provide a crown or cross slope at a minimum of inch/ft. across the pad.
- B. Construct the leading edge to form an exposed 8-inch barrier wall.
- C. Isolate footings from the pad with premolded joint filler.
- D. Finish pad surface and exposed edges to a smooth trowel finish.
- E. Curing: Uniformly apply curing compound over the entire surface after finishing, initial set and removal of side forms, in accordance with the manufacturer's printed instructions for the application.
- F. Protection: Do not remove forms for at least 24 hours after completion of concrete placement. Do not allow any traffic or other loading on pad until test data reveals design strength has been attained.

3.09 EQUIPMENT PAD

- A. Install pad in accordance with the general contours and spot elevations indicated. Provide a crown or cross slope at a minimum of 1/4 inch/ft. across the pad.
- B. Place pad in minimum 4 inch thickness of granular fill, placed and compacted as specified in Section 31 23 40.
- C. Chamfer exposed edges 3/4 inch.
- D. Finish exposed surfaces to have a light broom texture finish.
- E. Curing: Uniformly apply curing compound over the entire surface after finishing, initial set and removal of side forms, in accordance with the manufacture's printed instructions for the application.
- F. Protection: Do not remove forms for at least 24 hours after completion of concrete placement. Do not allow any traffic or other loading on pad until test data reveals design strength has been attained.

3.10 SIGN POST FOUNDATION

- A. Post footings may be cast if excavations remain stable. Place forms if excavations will not remain stable.
- B. Place concrete to level of adjacent grades with slight crown to shed water.
- C. Ensure signposts are plumb prior to initial set.

3.11 PROTECTION

- A. Protect installed items under provisions of Division 1 of the Specifications. In addition to specific protection measures specified above.
 - 1. Immediately after placement, protect pavement from premature drying, excessive temperatures and from mechanical injury. Maintain environmental and barrier protection for seven days after placement.
 - 2. Maintain concrete with a minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 - 3. Protect concrete form paint and stains.

3.12 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed in accordance with practices specified elsewhere in the specifications.
- B. Maintain records of placed concrete items. Record:
 - 1. Date.
 - 2. Location of pour.
 - 3. Quantity.
 - 4. Air temperature.
 - 5. Test samples taken.

END OF SECTION

SECTION 32 11 00
BASE COURSE FOR PAVEMENT

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Preparing subgrade to receive a base or pavement.
- B. Placing and compacting base material.

1.02 RELATED WORK

- A. Division 1: Testing Laboratory Services
- B. Section 31 11 00: Clearing and Grubbing
- C. Section 31 22 13: Site Excavation
- D. Section 32 05 23: Site Concrete Work
- E. Section 32 12 16: Asphaltic Concrete Paving

1.03 QUALITY ASSURANCE

- A. Perform work in accordance with the Missouri State Department of Highways and Public Transportation - latest Edition, hereinafter referred to as "State Highway Specifications."
- B. Qualifications of Asphaltic Concrete Producer: Use only materials which are furnished by a bulk asphaltic concrete producer regularly engaged in production of hot-mix, hot-laid asphaltic concrete.
- C. Owner will provide material testing and inspection for quality control during paving operations.

1.04 REFERENCE STANDARDS

- A. Gradation of stone materials will be performed in accordance with ASTM C136.

1.05 SUBMITTALS

- A. Use Materials and Resources Form to report materials' recycled content, local/regional content, and cost for MR Credits 4 & 5 per section 018113.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Mineral aggregate base (flexible base material, FBM) for asphaltic concrete pavement:
 - 1. Division 300, State Highway Specifications.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify compacted subgrade is dry and has been approved to receive the work of this Section.
- B. Verify gradients and elevations of subgrade are correct.
- C. Field Quality Control
 - 1. Proofroll subgrades that have been exposed to weather under provisions of Section 31 71 15. Repair any areas that received lime stabilization which show evidence of cracking or deterioration.
 - 2. Remove materials identified by Testing Agency Personnel. Backfill and compact such areas as specified in Section 31 23 40.

3.02 PLACING BASE COURSE

- A. Perform aggregate blending by approved stationary or travel plant methods. Mixing in stockpiles or on roadway will not be acceptable.
- B. Spread base material uniformly over the area to produce required lines, grades and cross-sections after compaction.

1. Indicated thickness of 6 inches or less may be constructed in a single course.
 2. Spread and compact thickness greater than 6 inches in at least 2 courses.
- C. Level and contour surfaces to the elevations and gradients indicated.
 - D. Compact each layer to 100% of the maximum dry density as determined by ASTM D 698.
 - E. Adjust moisture content to achieve near optimum moisture content prior to compaction. If excess water is apparent, scarify aggregate and aerate to reduce the moisture content.
 - F. Use mechanical hand tamping equipment in areas inaccessible to compaction equipment.
 - G. Conduct one density test, in accordance with ASTM D2167, for each 2500 sq. yds. of in-place material, but in no case, not less than one daily for each layer.

3.03 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with a 10 ft straight edge.
- B. Scheduled compaction thickness: Within 1/4 inch.
- C. Variation from true elevation: Within 1/2 inch.

3.04 FINISHING AND MAINTENANCE

- A. Finish surfaces by rolling with a smooth steel wheel roller. Water the surface and spread loose stones prior to rolling.
- B. Repair soft, yielding areas that develop in the final rolling.
- C. Maintain final surface in smooth and uniform condition until base course is covered by subsequent pavement construction.
- D. Protect surface from silting or erosion until placement of final pavement construction.
- E. Where areas are disturbed by traffic, weather or other means, grade and recompact as necessary.

END OF SECTION

SECTION 32 12 16
ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Mixing, spreading, compacting and finishing of bituminous pavements for base, leveling and surface courses on roads, parking lots, and other areas.

1.02 RELATED WORK

- A. Division One: Testing Laboratory Services
- B. Section 31 22 13: Site Excavation
- C. Section 32 11 00: Base Course for Pavement
- D. Section 31 23 40: Backfilling and Finished Grading
- E. Section 32 17 23: Pavement Marking

1.03 QUALITY ASSURANCE

- A. Perform work in accordance with the Missouri Department of Transportation, Road and Bridge Specifications, latest Edition, hereinafter referred to as "State Highway Specifications." Measurements and payments portions of those State Specifications do not apply to work performed under this contract.
- B. Mixing plant: Comply with requirements of State Highway Specifications.
- C. Qualifications of Asphaltic Concrete Producer: Use only materials which are furnished by a bulk asphaltic concrete producer regularly engaged in production of hot-mix, hot-laid asphaltic concrete.

1.04 PAVING QUALITY REQUIREMENTS

- A. General: In addition to other specified conditions, comply with the following minimum requirements.
 - 1. Test in-place asphaltic concrete courses for compliance with requirements for density, thickness and surface smoothness.
 - 2. Provide final surfaces or uniform texture, complying with required grades and cross-sections.
 - 3. Take not less than 4 in. diameter pavement specimens for each completed course, from locations as directed by Owner's Representative.
 - 4. Repair holes from test specimens as specified for patching defective work.
- B. Density
 - 1. Compare density of in-place material against laboratory specimen of same asphaltic concrete mixture, when subjected to 50 blows of standard Marshall hammer on each side of specimen.
 - 2. Minimum acceptable density of in-place course material is 97% of the recorded laboratory specimen density.

1.05 REGULATORY REQUIREMENTS

- A. Comply with applicable local standards, codes and ordinances for paving work on public property.

1.06 TESTS

- A. Testing and analysis of asphaltic mix will be performed under provisions of Division One.

1.07 SUBMITTALS

- A. Samples: Provide samples of materials for laboratory testing and job-mix design as required by Owner's Representative.
- B. Certificates:
 - 1. Provide certificates, in lieu of laboratory test reports.

2. Certify that materials comply with specification requirements.
3. Signed by asphaltic concrete producer and Contractor.
- C. Use Materials and Resources Form to report materials' recycled content, local/regional content, and cost for MR Credits 4 & 5 per section 018113.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt when the base surface temperature is less than 40o F.
- B. Do not apply materials when substrate is wet or contains sufficient moisture to prevent uniform distribution and proper penetration.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Primer: Class MC-30 medium curing liquid asphalt in accordance with AASHTO M82.
- B. Tack Coat: AASHTO M-140 emulsified asphalt, diluted with equal parts of water.
- C. Asphalt Cement: ASTM D946, 60-70 penetration grade.
- D. Aggregate: Sound and durable, angular crushed stone, sand or slag.
 1. Coarse aggregate: ASTM D692
 2. Fine aggregate: ASTM D1073
- E. Mineral filler: Shall meet the requirements of AASHTO M17 finely ground particles of limestone, hydrated lime, portland cement, or other approved mineral dust, free from foreign matter.

2.02 ASPHALT PAVING MIX

- A. Use dry materials to avoid foaming. Mix uniformly.
- B. Mix designation: State Highway Specification Sections as follows:
 1. Asphaltic Concrete Surface Course: Division 300
 2. Asphaltic Binder Course: Division 300.
- C. Job mix formula: Base on the Marshall design method for compaction of 50 blows each side of specimen and the following test criteria:
 1. Refer to specific criteria contained within the geotechnical engineering report.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.
- C. Beginning of installation means acceptance of substrate.

3.02 PREPARATION

- A. Prepare mix materials and place of deposit in accordance with referenced state highway specifications.
- B. Prime Coat:
 1. Apply over substrate in accordance with the manufacturers printed instructions at the rate of .3 gal/sq. yd.
 2. Use clean sand to blot excess primer. Use only enough sand to prevent pick-up under traffic. Remove loose sand before paving.
- C. Tack Coat:
 1. Apply to contact surfaces of concrete items which abut pavement.
 2. Apply to contact surfaces of existing asphalt or concrete pavement at the rate of .05 to .15 gal/sq yd of surface.
- D. Frames of subsurface structures:

1. Coat surfaces of new and existing frames with oil to prevent bond with asphalt paving.
2. Set to be flush with finish surface and surround with a ring of compacted asphaltic concrete to one inch below top of frame. Adjust as required to meet paving.
3. Provide temporary covers over openings until completion of rolling operations.

3.03 PLACING ASPHALT PAVEMENT

- A. Place materials in accordance with referenced State Highway Specifications.
- B. Place, spread and strike-off to compacted thickness indicated with paving machine, except that inaccessible and small areas may be placed by hand.
- C. Compact pavement by rolling. Do not displace or extrude pavement from position. Hand compact area inaccessible to rolling equipment.
 1. Average relative density: Minimum of 97%.
 2. Individual relative density: Minimum of 94%.
- D. Develop rolling with consecutive passes to achieve even and smooth finish of uniform texture, without roller marks.
- E. Make joints between successive days work, or between old and new pavements in accordance with referenced State Highway Specifications. Ensure a continuous bond is attained.

3.04 TOLERANCES

- A. Flatness: +1/4-inch measured with a 10 ft. straight edge.
- B. Compacted scheduled thickness: +1/4-inch of design thickness.
- C. Variation from true elevation: 0.05 feet.

3.05 PATCHING

- A. Remove defective or deficient areas for full depth of course.
 1. Cut sides parallel and perpendicular to direction of traffic with edges vertical.
 2. Apply tack coat to exposed surfaces and place asphalt on prepared surfaces as specified above.
- B. Repair and patch holes resulting from test cores as specified above.

3.06 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed as defined in Division 1 of the specifications.

3.07 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 7 days.
- B. Cover openings of substrate structures in paved area until permanent coverings are placed.

3.08 SCHEDULE OF PAVEMENT SECTIONS

- A. Place and compact materials to the thickness called for on the Drawings.

END OF SECTION

SECTION 32 17 23
PAVEMENT MARKING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Marking of pavement including surface preparation and painting on bituminous or concrete surface.

1.02 ACCEPTANCE PROCEDURE

- A. Typical Sample Analysis
- B. Certification that paint meets requirements

1.03 SUBMITTALS

- A. Use Materials and Resources Form to report materials' recycled content, local/regional content, and cost for MR Credits 4 & 5 per section 018113.

PART 2 PRODUCTS

2.01 READY-MIXED PAINT

- A. Paint: Porter traffic paint, colors as follows.
 - 1. Parking lines and directional arrows: White.
 - 2. No parking striped islands: Yellow
 - 3. Handicapped symbols: Blue
 - 4. Fire Lane Striping: Red
- B. Substitutions: Materials of the same function and performance are acceptable under provisions defined in Division 1 of the Specifications.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Prepare surface and apply paint with provisions of consistent agitation of paint with guns capable of applying a solid consistent marking.
- B. Apply paint markings to have true, sharp edges and ends, with lines of correct lengths, widths and curvatures. Paint application to be performed in accordance with manufacturer's recommendations.
- C. Protection:
 - 1. Take precautions necessary to insure that paint does not soil adjacent surfaces.
 - 2. Place warning signs and traffic cones or similar devices to protect markings from being tracked by pedestrians or vehicles.
 - 3. Efface any tracked paint from adjacent areas and repair pavement markings.

END OF SECTION

SECTION 32 80 00
IRRIGATION SYSTEM

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Reworking of existing irrigation system affected by the construction of retrofit and/or expand the system to cover the proposed lawn areas.
- B. Design of irrigation system on a design build basis and preparation of shop drawings of proposed layout for submission to and approval by the Owner's Representative.
- C. Complete, operable irrigation system.

1.02 RELATED WORK

- A. Division One: Submittals
- B. Division One: Contract Close Out.
- C. Section 31 22 13: Site Excavation
- D. Division 16: Electrical work other than 24V wiring.

1.03 QUALITY ASSURANCE

- A. Comply with requirements of local Codes Department jurisdiction.
- B. Obtain required permits and notices.
- C. Contractor to be a Toro or Rainbird certified installer.

1.04 PROTECTION

- A. Protect existing on-site construction, existing plants and trees, and miscellaneous landscape to remain.

1.05 COORDINATION

- A. Coordinate this work with other trades whose work is affected, so that work is performed in a systematic sequence.

1.06 SUBMITTALS

- A. Submit items to Owner's Representative in accordance with Section 01 33 10.
- B. Submit six copies of manufacturer's product data describing piping and components of system.
- C. Prepare an irrigation design consistent with applicable codes illustrating proposed irrigation head layout and fixture specifications, piping diagram with sizes and controller information. The plan shall have individual zones dedicated to trees, turf areas and shrub/groundcover areas.

1.07 DELIVERY AND HANDLING

- A. Deliver mechanical and electrical components in manufacturer's unopened packaging.
- B. Store materials in accordance with manufacturer's recommendations.

1.8 PROJECT RECORD DRAWING

- A. Neatly mark a clean print to indicate actual locations of underground pipes, valves, sprinkler heads, and control items. Identify locations by dimensioning from building walls or other fixed points, and depth below surface.
- B. Upon final inspection, deliver one (1) hardcopy and one (1) electronic file of marked drawing to Owner's Representative.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

- A. Irrigation components to be manufactured by either Toro, Inc. or Rainbird, Inc.
- B. Provide a system where all components are compatible.

2.02 PIPING

- A. Pipe 3/4" through 1-1/2" diameter: PVC, Class 200, Type 1120 or 1220, meeting requirements of CS-256-63.
- B. Pipe 2" through 4" diameter: PVC, unplasticized, Class 200, with bell and spigot joints.
- C. Provide pipe continuously marked its entire length with identity of manufacturer, type, class, and size.

2.03 FITTINGS

- A. Fittings for zone piping : PVC, Schedule 40, Type 1, domestic manufacturer, and marked to identify pressure rating or schedule number.
- B. Fittings for mainline: Harco D.I.P. fittings
- C. Make connections between plastic pipe and metal valves and piping with threaded fittings, using female plastic adapters and threaded nipples. Do not use male adapters.

2.04 PIPE SLEEVES (CONDUITS)

- A. PVC pipe, Schedule 40 of sizes to fit conditions.

2.05 ELECTRICAL CONDUIT

- A. Rigid conduit: Hot-dip galvanized, or electro galvanized with matching couplings and connections. Size to suit conditions.

2.06 RISER AND SWING JOINT NIPPLES

- A. Poly Pipe, with insert fittings:
 - 1. 3/8" inside diameter pipe.
- B. Rigid Swing Joints:
 - 1. Schedule 40 fittings per details.

2.07 SOLVENT CEMENT

- A. Make joints in PVC pipe and fitting with solvent cement recommended by pipe manufacturer.

2.08 CONTROL WIRING

- A. Wire: Time conductor, UL approved, 14 gauge, U.F. type wire with insulation color different to 115V service to equipment.
- B. Ground: Single strand, UL approved, 14 gauge, U.F. direct burial wire with insulation color different to 24 volt and 115V wiring.
- C. Splicing Kits: Waterproof 3M DBY Kits.

2.09 CONTROL EQUIPMENT

- A. Automatic Controller: Hunter ACC-1200 or approved equal, with program features for operation sequences specified herein and surge protection. Contractor to provide within budget one new 12-station controller. Features required:
 - 1. Field adjustable for minor timing adjustments.
 - 2. No time lag in sprinkling operations where controller switches between sections or stations.
 - 3. Continued manual operation if timing mechanism is removed.
 - 4. Water conservation programming capability.
- B. Controller Enclosure: A sturdy, lockable, metal mounting box, easily accessible for maintenance.
- C. Automatic Control Valves: Rain Bird., or approved equal, compatible with automatic controller.

2.10 RAIN GAUGE SENSOR

- A. Hunter rain and freeze sensor.

2.11 SPRINKLER HEADS

- A. Hunter, Toro , or Rainbird sprinkler heads.

2.12 GATE VALVES AND BOXES

- A. Valves: Plastic with screwed connections, non-rising valve stem, cross handle, minimum rated working pressure of 150 psi. with pressure regulation.
- B. Boxes: Ametek valve boxes with covers. Types and sizes are indicated.

2.13 SERVICE SADDLES

- A. Smith - Blair, double strap, all bronze.

2.14 BACKFILL MATERIAL

- A. Topsoil: Natural, fertile, friable, productive soil, neither excessively acid nor alkaline, and free from toxic substances, stones, weeds, clay, clods, roots, cinders and debris.
- B. Aggregate: Crushed stone or clean natural gravel, ASTM D448, Size 16-6.

PART 3 EXECUTION

3.01 PREPARATION

- A. Stake out sprinkler locations before starting excavation work. Obtain approval of Owner's Representative before proceeding.

3.02 TRENCHING AND BACKFILLING

- A. Trenching: Provide smooth bottoms to allow pipe to be uniformly supported over its entire length. All pipe shall be below the freeze depth and at least 18 inches below finish grade as determined by Owner's Representative.
 - 1. Trench sizes:
 - a. For pipe 2" diameter and over: 2" wider than pipe with 24" minimum earth cover over top of pipe.
 - b. For pipe up to 2" diameter: 2" wider than pipe with 12" minimum earth cover over pipe.
 - 2. Trenches under paved areas:
 - a. Wherever possible install pipes in PVC sleeves before pavements are placed.
 - b. Trench depth of pavement subgrade plus depth required to place aggregate below pipe, and so top of pipe is even with or below subgrade level.
 - c. If necessary to cut through existing pavements, cut pavements to width of trench and excavate to subgrade plus depth required. See b. above. When pipe is installed and tested, neatly replace base material and pavements.
 - 3. Trenching in sodded areas; remove and preserve sod. Perform trenching when pipe has been installed and tested, backfill trenches and restore sod.
 - 4. Do not trench closer than 5'-0" to any tree.
- B. Backfilling:
 - 1. Material removed in trenching operations may be reused provided it meets requirements for specified topsoil.
 - 2. Backfill trenches with specified topsoil. Place topsoil by hand in 6" lifts and tamp for compaction. Compact to a minimum density of 90% maximum dry density, ASTM D-698. Finish surface with a slight crown to allow for settlement.
- C. Backfill only when pipe is cool. Pipes may be cooled by circulating water in pipe.
- D. Where trenches run under pavement, place specified aggregate in trenches below pipe, and over pipe to depth matching aggregate base under pavement.

3.03 INSTALLING PIPES

- A. Install piping in accordance with manufacturer's printed instructions.
- B. Where pipes run under pavements install pipe in PVC pipe conduit (sleeve) and extend conduit 36" beyond each edge of payment.
- C. Pipe 2" diameter and larger: Install concrete thrust blocks at changes in direction.

- D. Before installing lateral lines, flush main system and pressure test for 24 hours. Repair leaks and retest until leaks are stopped.

3.04 INSTALLING VALVE BOXES

- A. Install valves to allow for isolating sections of system, and for draining system. System must drain in such a manner to preclude pipe breakage due to freezing. Install these at the pump discharge and near the opposite side of the property on the mainline.
- B. Excavate for valve and drain boxes and allow 2" below bottom of pipe for aggregate fill.
- C. Install valve boxes and aggregate fill.
- D. Backfill around boxes with topsoil and compact. Valve boxes tops shall be flush with surrounding soil level of sod.

3.05 INSTALLING SPRINKLER HEADS

- A. Install sprinkler heads on swing joints in accordance with details and manufacturer's printed instructions.
- B. Install so that top of each head is slightly above finished grade. Do not install sprinkler heads until finished grading is complete.
- C. Backfill around swing joints and sprinkler heads with specified topsoil.

3.06 INSTALLING CONTROL WIRING

- A. Install wire without kinks or bends. Tape together at two foot intervals and then tape this bundle to the side of the main line at five foot intervals with at least two wraps of electrical tape.
- B. Where wires run under paving, install wires in PVC pipe conduit (sleeve) and extend conduit 36" beyond each edge of pavement.
- C. Install wiring in accordance with manufacturer's printed instructions and applicable codes.

3.07 INSTALLING CONTROL EQUIPMENT

- A. Install control equipment where indicated and in accordance with manufacturer's written instructions.

3.08 TESTING

- A. Upon completion, test entire system for proper operation.
- B. Flush air from the entire system.
- C. Apply a continuous, static water pressure of 60-40 psi with the risers capped. Apply pressure to:
 - 1. Main lines and submain lines for 12 hours.
 - 2. Lateral lines for 2 hours.
- D. Repair leaks and retest until leaks are stopped.

3.09 BALANCING AND ADJUSTING

- A. Balance and adjust components of sprinkler system so that overall operation is efficient.
 - 1. Synchronize controllers.
 - 2. Adjust pressure regulators and pressure relief valves.
 - 3. Adjust sprinkler heads; if required.
 - 4. Adjust individual station control if required.

3.10 TRAINING OWNER'S DESIGNATED EMPLOYEES

- A. Train Owner's designated personnel in operation, care and maintenance of the system and provide data as required.
- B. Have a trained, qualified person, thoroughly familiar with individual system, conduct training session.
- C. Allot one full day for training.

- D. Provide a “redlined” as-built drawing of record document to the Owner’s designated personnel.

3.11 CLEAN-UP

- A. Clean up grounds and sprinkler system.
- B. Remove excess material, excess earth, rock, and equipment from project site.

END OF SECTION

SECTION 32 92 23

SODDING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Provide all of the labor, materials, equipment, and services required to furnish and install the sodding. The work shall include, but not be limited to, the following:
 - 1. Soil preparation.
 - 2. Sodding lawns, and other indicated areas.

1.02 RELATED WORK

- A. Section 32 80 00: Irrigation System
- B. Section 32 93 10: Trees, Plants, and Groundcovers

1.03 QUALITY ASSURANCE

- A. Comply with Section 01 40 00 requirements.
- B. Sod: Comply with American Sod Producers Association (ASPA) classes of sod materials.
- C. Provide and pay for materials testing. Testing agency shall be acceptable to the Architect.
Provide the following data:
 - 1. Test representative material samples proposed for use.
 - 2. Topsoil: pH factor Mechanical analysis Percentage of organic content
Recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring nutrients to satisfactory level for planting.

1.04 SUBMITTALS

- A. Submit sod growers certification of grass species. Identify source location.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Cut, deliver and install sod within a 24-hour period.
 - 1. Do not harvest or transport sod when moisture content may adversely affect sod survival.
 - 2. Protect sod from sun, wind, and dehydration prior to installation.
 - 3. Do not tear, stretch, or drop sod during handling and installation.

1.06 PROJECT CONDITIONS

- A. Work notification: Notify Architect at least 7 working days prior to start of sodding operations.
- B. Protect existing utilities, paving, and other facilities from damage caused by sodding operations.
- C. Perform sodding work only after planting and other work affecting ground surface has been completed.
- D. Provide hose and lawn watering equipment as required.
- E. Where applicable, the irrigation system will be installed prior to sodding. Locate, protect, and maintain the irrigation system during sodding operations. Repair irrigation system components damaged during sodding operations at the Contractor's expense.

1.07 WARRANTY

- A. Provide a uniform stand of grass by watering, mowing, and maintaining lawn areas until final acceptance. Resod areas, with specified materials, which fail to provide a uniform stand of grass until all affected areas are accepted by the Architect.

PART 2 PRODUCTS

2.01 SOD

- A. Provide well-rooted, healthy sod, free of diseases, nematodes and soil borne insects. Provide sod uniform in color, leaf texture, density, and free of weeds, undesirable grasses, stones, roots, thatch, and extraneous material; viable and capable of growth and development when planted.
- B. An "approved" nursery grown blend of improved Bahia varieties.
 - 1. Sod containing, Quackgrass, Johnsongrass, Poison Ivy, Nutsedge, Nimblewill, Canada Thistle, Timothy, Bentgrass, Wild Garlic, Ground Ivy, Perennial Sorrel, or Bromegrass weeds will not be acceptable.
 - 2. Furnish sod machine stripped in square pads or strips not more than 3'-0" long; uniformly 1" to 1" thick with clean cut edges. Mow sod before stripping.

2.02 SOIL AMENDMENT MATERIALS

- A. Commercial Fertilizer: Granular, non-burning product compound of not less than 50% organic slow acting, guaranteed analysis professional fertilizer. Grade 6-12-12.
- B. Lime: Ground limestone, dolomite type, with minimum of 95% carbonates.

2.03 WATER

- A. Free of substance harmful to sod growth. Hoses or other methods of transportation furnished by Contractor.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine finish surfaces, grades, topsoil quality and depth. Do not start sodding work until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Limit preparation to areas which will be immediately sodded.
- B. Loosen topsoil of lawn areas to minimum depth of 4". Remove stones over 1" in any dimension and sticks, roots, rubbish, and extraneous matter.
- C. Grade lawn areas to a smooth, free draining and even surface with a loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions as required to drain.
- D. Apply fertilizer at a rate of 18 lbs per 1,000 sq. ft. Adjust proportions based upon recommendations resulting from soil test. Mix thoroughly into upper 2 inches of topsoil.
- E. Dampen dry soil prior to sodding.
- F. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading and prior to sodding.

3.03 INSTALLATION

- A. Sodding:
 - 1. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips.
 - 2. Do not overlay edges. Stagger strips to offset joints in adjacent grass. Provide sod pad top flush with adjacent curbs, sidewalks, drains, and seeded areas.
 - 3. Install initial row of sod in a straight line, beginning at bottom of slopes, perpendicular to direction of the sloped area. Place subsequent rows parallel to and lightly against previously installed row.
 - 4. Water sod thoroughly with a fine spray immediately after laying.
 - 5. Roll with light lawn roller to ensure contact with sub-grade.
 - 6. Sod indicated areas within contract limits and areas adjoining contract limits disturbed as a result of construction operations.

7. On slopes of two to one or steeper, pinning or pegging may be required to hold the sod in place.

3.04 MAINTENANCE

- A. Maintain sodded lawns until completion and acceptance of the entire project.
- B. Maintain sodded lawn areas, including watering, spot weeding, mowing, application of herbicides, fungicides, insecticides and resodding until a full, uniform stand of grass free of weed, undesirable grass species, disease, and insects is achieved and accepted by the Owner.
 1. Water sod thoroughly daily to establish proper rooting.
 2. Repair, rework, and resod all areas that have washed out or are eroded. Replace undesirable or dead areas with new sod.
 3. Mow lawn areas as soon as lawn top growth reaches a (3") height. Cut back to (2") height. Repeat mowing as required to maintain specified height. Not more than 40% of grass leaf shall be removed at any single mowing.
- C. Apply herbicides as required to control weed growth or undesirable grass species.
- D. Apply fungicides and insecticides as required to control diseases and insects.

3.05 ACCEPTANCE

- A. Inspection to determine acceptance of sodded lawns will be made by the Architect, upon
- B. Contractor's request. Provide notification at least 7 working days before requested inspection date.
 1. Sodded areas will be acceptable provided all requirements, including maintenance, have been complied with, and a healthy, even colored Viable lawn is established, free of weeds, undesirable grass species, disease, and insects.
- B. Upon acceptance, the Owner will assume lawn maintenance.

3.06 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, conduit markers, and equipment. Repair damage resulting from sodding operations. Cleaning shall continue until acceptance by Owner.

END OF SECTION

SECTION 32 93 10
TREES, PLANTS AND GROUNDCOVER

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Provide all labor, equipment, materials and services necessary to complete the Work of this Section including:
 - 1. Providing and installing trees, shrubs, groundcovers, sod and seed for landscape planting.
 - 2. Fine grading of topsoil for all exterior areas to receive planting, mulch, seed or sod as specified.
 - 3. Specified Maintenance Period and One-Year Guarantee Period.
 - 4. Irrigation Work shall be provided as a subcontract to the Work of this Section.

1.2 RELATED WORK

- A. Irrigation System: Section 32 80 00
- B. Backfilling and Finish Grading: Section 31 23 40

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. All plant materials to comply with State and Federal laws relating to inspection for disease and insect control.
 - 2. Plant material size and grades to conform to "American Standard for Nursery Stock." American Association of Nurserymen, Inc. Latest approved revision, ANSI Z-60-1.
 - 3. Plant material nomenclature to conform to:
 - a. "Standardized Plant Names" as adopted by the Joint Committee of Horticulture Nomenclature, latest revision.
 - b. Names not listed in the above standard to comply with those most commonly used in the trade.
 - c. In all cases, botanical names take precedence over common names.
- B. Qualification of Personnel: Use adequate numbers of skilled workmen trained and experienced in the Work and familiar with requirements and methods needed for performance of the Work. At all times during planting operations, have on the site in a supervisory role a man knowledgeable in horticultural practices as defined in 3.08 Maintenance D.1 a-c herein.
- C. Inspection and Approval:
 - 1. All plant material is subject to inspection and approval in the field or nursery before digging, by the Landscape Architect.
 - 2. All plant materials and other materials are subject to inspection and approval at the site before planting or placing or at any other time.
 - 3. Attach secure, durable, legible waterproof labels, stating correct botanical and common names as specified, to at least one plant, bundle or container of each plant variety.
 - 4. Immediately remove from the site plant materials or other materials not complying with specified requirements.
 - 5. Approval is for visual qualities only and does not relieve the Contractor of his obligation to provide materials and workmanship in full compliance with all specifications.

1.4 SUBMITTALS

- A. Materials Lists:
 - 1. On the bid date, bidder shall be prepared to submit a complete list of materials demonstrating source, availability, and conformance with requirements specified.
 - 2. For trees not specified as pre-selected and tagged, submit color photographs of representative plants with materials unit price list to the satisfaction of the Landscape Architect.
 - 3. Substitutions not permitted unless proof is submitted to Landscape Architect's satisfaction that the material is unavailable as specified.

- B. Maintenance Manual: In 3-ring binder, typewritten schedule and procedures for annual landscape maintenance, by Contractor to Owner and Landscape Architect.

1.5 PRECAUTIONS

- A. Examine conditions under which Work is to be performed and notify the Landscape Architect of unsatisfactory conditions.
- B. Determine locations of underground utilities and perform Work in a manner, which will avoid all possible damage. Hand excavate as required.

1.6 COORDINATION

- A. Coordinate the Work of this Section with that of other trades.
- B. Do not perform the Work until conditions are satisfactory and acceptable.
- C. Maintain stakes set by others until all parties mutually agree upon removal.
- D. Inform Landscape Architect in writing, prior to planting, of conditions existing which could be considered detrimental to the successful planting and growth of any plant material, including but not limited to subsurface drainage conditions, utility locations, subgrade compaction, percolation, rate and elevations.

1.7 HANDLING, DELIVERY AND STORAGE

- A. Deliver packaged material in manufacturer's original containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored at the site.
- B. Deliver all non-packaged or non-containerized materials to site in a manner that will prevent loss, damage, deterioration or contamination.
- C. Store all materials in approved locations and to prevent loss, damage, deterioration or contamination.
- D. Delivery, storage and handling of all plant materials shall conform to the following:
 - 1. Do not prune prior to delivery.
 - 2. Do not bend or bind trees or shrubs on such a manner as to damage bark, break branches or destroy natural shape.
 - 3. Provide protective covering during delivery.
 - 4. Deliver plants after preparations for planting have been completed and approved. Plant immediately.

1.8 SITE MAINTENANCE

- A. Keep roads, paving and structures adjacent to planting operations clean and free of obstructions, mud and debris at all times.
- B. Do not permit flushing of roads or disposal of dirt or debris into sewers or drainage ditches.
- C. Control dust from planting operations.
- D. Remove trash, debris and rejected materials from the site daily as the work progresses.

PART 2 PRODUCTS

2.1 PLANT MATERIALS

- A. Plant Material:
 - 1. Definition: trees, shrubs and groundcover listed in the Plant Schedule in the Drawing.
 - 2. General:
 - a. Species, size, manner in which to be planted, and approximate quantities to complete planting as indicated are included in the Plant Schedule. It is the Contractor's responsibility to check these quantities to allow for the correct quantity of plants based on the plan. Any discrepancies should be pointed out to the Landscape Architect prior to bid.
 - b. Plants shall remain the property of the Contractor until Substantial Completion.

- c. Scientific and common plant names conform to those given in Standardized Plant Names or are those generally accepted in the nursery trade.
- 3. Quality:
 - a. Missouri No. 1 or better, to name and type. Plants, which are not of the highest quality, will be rejected.
 - b. Nursery-grown, unless specified otherwise.
 - c. In compliance with State and Federal laws relating to disease.
 - d. Having normal, well-developed branches and vigorous root systems.
 - e. Healthy, vigorous, free from defects, decay and disfigurements, sunscald injuries, abrasions of the bark, plant disease, insect pests or eggs, borers, and all forms of infestations or objectionable disfigurements.
 - f. Reject plants lacking compactness or proper proportions, plants that are weak or thin or are injured by too close planting in nursery rows.
 - g. Plants which have been cut back from larger grades to meet certain specified requirements will be rejected.
 - h. Plants with undersized, dry, cracked or broken balls, or which are loose in their balls will be rejected.
 - i. Container-grown material: Grown for one growing season in the container in which it is delivered; free from weeds and grasses. Root bound material will be rejected.
- 4. Size:
 - a. Sizes and proportions shall be equal to those recommended by the "American Standard for Nursery Stock" for specified grades.
 - b. Measure plants before pruning and with branches in normal position.
 - c. Equal or exceed measurements specified in Plant Schedule, which are the minimum acceptable; provide at least 50% of the plant material at the maximum size specified.
 - d. Height and spread dimensions: General body mass of plant, not from branch tip to tip.
 - e. Well-proportioned as to height; reject plants which meet specified measurements but do not possess an overall balance.
 - f. Take caliper measurements on trunk 6 inches above natural ground level up to and including 4-inch caliper size; 12 inches above natural ground level for larger sizes.
 - g. Container-grown plants: conform to standards set forth in "American Standard for Nursery Stock for container-grown plants.
- 5. Quantity: Furnish plants in sufficient quantity to satisfy the intent of Drawings and Specifications. Locate in sufficient quantity so that time is not lost if some plants are rejected.

2.2 TOPSOIL MATERIALS AND AMENDMENTS

- A. Topsoil: stockpiled by others on site for use in planting operation.
 - 1. Characteristics of approved topsoil:
 - a. Fertile, friable, naturally occurring topsoil, free of stones, subsoil, clay lumps, hardpan, roots, stumps, branches, sticks and other debris larger than two inches in any dimension; free of noxious weeds, grasses, seeds, plants, extraneous matter and any substance harmful to plant growth.
 - b. PH 5.0 to 7.0
 - c. Organic Matter 5% to 10%
 - d. Sand 50% to 70%
 - e. Silt less than 30%
 - f. Clay 10% to 25%
 - g. Permeability Rate of 5 x 10⁻³ centimeters or greater at 85% compaction.
- B. Testing for topsoil:
 - 1. Sample and test minimum of three samples of stockpiled topsoil for compliance with specified characteristics. Tests to be performed by soil testing lab approved in advance by Landscape Architect, by Contractor at Owner's expense. Amend per recommendations of Soil Test Report and as approved to meet specified characteristics.
- C. Commercial Fertilizer:

1. Characteristics:
 - a. Uniform in composition, dry and free flowing.
 - b. Delivered in original, unopened containers each bearing the manufacturer's guaranteed analysis.
 2. Of the formulation recommended in the Soil Test Report as specified.
 3. Acceptable manufacturers:
 - a. Sta-Green Plant Food Co.; Sta-Green
 - b. O.M. Scott & Sons, Inc.; Scott's
 - c. Approved equal
- D. Lime:
1. Ground or crushed agricultural lime.
 2. Containing not less than 85% of total carbonates.
 3. 90% passing 20-mesh screen.
 4. Not less than 50% passing a 60-mesh screen.
 5. Dry and free flowing.
 6. Apply at rate specified in Soil Test Report.
- E. Topsoil Mix:
1. Prepare all topsoil used in tree and shrub pits and groundcover beds and planters in the following proportions:
 - a. 50% approved material excavated from the pits (0% if excavation is in rock).
 - b. 50% prepared soil in the following proportions (100% if excavation is in rock):
 - c. 2 parts by volume topsoil as specified in 2.02 A herein.
 - d. 1 part by volume organic matter (peat moss and/or soil conditioner).
 - e. 1 part by volume sand
 2. Add fertilizer at rate specified in Soil Test Report.
- F. Peat Moss:
1. Horticultural grade (fibrous type, finely shredded).
 2. Canadian or German stocks, consisting has partially composed vegetable pH between 4 and 6.
 3. Containing no minerals harmful to plant growth.
- G. Pine Bark
1. 100% Shredded Pine Bark Fines:
 - a. Free from wood, wood shaving, cambium, sawdust, leaves, twigs, insects, grasses, weeds, plants and their seeds, other foreign material and any substance harmful to plant growth.
- H. Soil Conditioner:
1. Well-rotted organic matter of uniform composition.
 2. Containing no weeds, grasses, plants or their seeds nor any substance harmful to plant growth.
 3. Acceptable manufacturers:
 - a. Klumb Company, "Soil conditioner," Tuscaloosa, AL
 - b. Soil Products, "Metro-Nitro Humas Compost," Hermitage, TN.
 - c. Approved equal.
- I. Polymer Crystals:
1. Nondegradable water-storing polymers 1.0 to 3.0 millimeters in size.
 2. Acceptable Product:
 - a. Terrasorb AG as manufacturer by Industrial Services International, Inc., Bradenton, FL.

2.3 MULCH

- A. 100% Pine Needle Mulch (tree, plant and groundcover pits and beds):
1. Free from wood, wood shavings, cambium, sawdust, leaves, twigs, insects, grasses, weeds, plants and their seeds, other foreign material and any other substance harmful to plant growth.

2.4 GUYING, STAKING AND WRAPPING

- A. Wood Stakes:
 - 1. Pressure-treated Southern Yellow Pine, or other approved wood, 2" x 4" x length specified in the Drawings, pointed at one end.
 - 2. Above-ground portion painted black.
 - 3. Free from insects and fungi.
- B. Wire:
 - 1. Pliable #10 or #12 gauge galvanized steel wire, double and twisted.
- C. Turnbuckles:
 - 1. Galvanized turnbuckles, as detailed and approved by Landscape Architect.
- D. Tree Strap:
 - 1. Polypropylene web straps with 2 brass eyelets.
 - 2. 2" minimum width.
 - 3. Olive in color.
- E. Tree Wrap:
 - 1. Standard manufactured tree wrapping paper.
 - 2. First quality bituminous impregnated tape, corrugated or crepe paper, brown in color.
 - 3. Not less than 4" nor more than 6" wide.
 - 4. Tying material: Jute twine of at least 2-ply strength.

2.5 WATER

- A. Fresh water, free of impurities or any substance harmful to plant growth.
- B. Provided by Owner.
- C. Provide all hose, attachments and accessories necessary to complete the Work as specified.

PART 3 EXECUTION

3.1 GRADING

- A. Topsoil shall be spread and rough graded by others in all areas indicated in the Drawings to receive planting, mulch, seed or sod.
- B. Fine grade topsoil to form smooth grades, eliminating irregularities and ponding.
- C. Remove extraneous matter measuring 1" or larger in any dimension from top four inches (4") of placed topsoil.
- D. Eliminate all unwanted vegetative growth from topsoil by approved means before planting is commenced.
- E. Obtain approval of finished grades before proceeding with planting operations; eliminate irregularities and ponding.

3.2 TOPSOIL MIXES

- A. Prepare topsoil mixes as specified in 2.02 (E & F) herein.
- B. Obtain approval of topsoil mix before commencing planting operations. Do not mix in place with placed topsoil.
- C. Remove extraneous matter measuring 1" or larger in any dimension within topsoil mix.
- D. Place topsoil mix as backfill for tree and shrub pits and ground cover beds as drawn.
- E. Protect topsoil mix from erosion by force of wind or water, or damage by traffic.

3.3 PLANT LAYOUT

- A. Stake plant locations and areas for approval prior to planting.
- B. Do not dig plant pits prior to obtaining Landscape Architect's approval of plant locations.
- C. Make adjustments in plant locations as directed.

- D. If underground obstructions are encountered in planting areas, alternate locations may be selected by the Landscape Architect at no additional cost to the Owner.

3.4 PLANTING

- A. Place plants which comprise a planting composition in approved staked locations for final approval by Landscape Architect.
- B. Plant Pits and Beds:
 - 1. Drainage:
 - a. Landscape contractor is responsible for achieving and maintaining adequate drainage from all plant pits and beds. Use specified or other approved means.
 - b. 48 hours prior to planting, test each plant pit for adequate drainage.
 - c. Drainage is considered inadequate if pit or bed holds water for 24 hours or more.
 - d. Owner reserves the right to test tree or plant pits at any time for adequate drainage. Correct immediately any inadequate drainage encountered.
 - e. Submit proposal for Contractor's preferred tree pit drainage method(s) with Bid Proposal.
 - 2. Pits are generally circular in outline with vertical sides.
 - 3. Tree pits 2' greater in diameter than ball or root spread.
 - 4. Shrub pits 1' greater in diameter than ball or root spread.
 - 5. Prepare as specified in detail Drawings.
- C. Setting Plants:
 - 1. Set plants uniformly 2" to 4" height than surrounding grade or as necessary to provide adequate positive drainage away from roots. Slope soil gradually from saucer.
 - 2. Cut rope, wire or string from top of ball after plant has been set; turn down and bury burlap.
- D. Backfilling Plants:
 - 1. Backfill to 2/3 full with specified topsoil mix.
 - 2. Water thoroughly to eliminate air pockets and settling before filling to grade.
 - 3. Form shallow saucer at plant pit edge to hold water.
 - 4. Water in thoroughly.
- E. Staking and Wrapping:
 - 1. Inspect tree trunks for injury, improper pruning and insect infestation; take corrective measure before wrapping.
 - 2. Immediately after planting, stake and wrap trees as detailed.
 - 3. Wind wrapping material spirally from the ground line of the trunk to the second branch, allowing 50% overlap. Tie at no less than five places, including bottom, middle and top.
 - 4. Secure trees in rooftop planters via guys and turnbuckles to eyebolts provided with planters.
- F. Pruning:
 - 1. Do not prune plants without approval of the Landscape Architect.
 - 2. Prune after plants are in place and ONLY at the direction of the Landscape Architect.
 - 3. Main leaders of trees to remain intact.
 - 4. Paint all cuts over 1/2" in diameter with approved tree wound dressing.
- G. Finished Grading: Hand grade and rake planting areas so that grades conform to surrounding areas and surface water drains freely.
- H. Mulching:
 - 1. Mulch all plant pits and beds with 4" deep specified mulch, uniform throughout.
 - 2. Spread mulch solid in planting beds.

3.5 MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Continue maintenance for thirty calendar days following Substantial Completion.
- C. Provide labor, materials, equipment and means for proper maintenance of all plant materials and workmanship.

- D. Supervision:
1. Maintenance program, schedule and operations shall be supervised by a person(s) having one or more of the following qualifications:
 - a. Is a Certified Nurseryman.
 - b. Is a Licensed Horticulturist?
 - c. Has a State Setting and Maintenance License.
 2. Submit a written report and conduct joint inspection, with the Landscape Architect, of the maintenance program and procedures, at inspection for Substantial Completion and at end of Maintenance Period.
- E. Maintenance of trees, shrubs and groundcovers:
1. Maintain all plants in a growing, well-formed, healthy condition by watering, fertilizing, pruning, weeding, spraying, wrapping, straightening, and replacement or by any other necessary maintenance operations.
 2. Watering:
 - a. Monitor Owner's automatic water system and schedule for proper watering of all plant material.
 - b. Advise Landscape Architect immediately of recommended alterations due to weather or other conditions.
 - c. Water landscaped areas not covered by automatic watering system as frequently as necessary to maintain proper moisture level, using the following schedule as a guide:
 1. Twice a month during March, April, May.
 2. Once a week during June, July, August, September.
 3. No watering from October through February, except in drought conditions.
 - d. Arrange for activation in mid-March, unless otherwise directed.
 3. Fertilizing:
 - a. Mid-March application of 23-3-3 (slow release nitrogen).
 - b. August 1 application of 15-0-15.
 4. Pruning:
 - a. Remove dead wood as it becomes evident.
 - b. Remove living portions of plants only at the direction of the Landscape Architect.
 5. Wilt-proofing: Apply approved anti-desiccant to all evergreen trees during first two weeks in December (except pines).
 6. Spraying:
 - a. For each spraying, combine approved insecticide and fungicide to provide maximum protection for all plant materials.
 - b. Three sprayings annually: in March, May and August.
 7. Weeding:
 - a. Two applications (spring and fall) of approved insecticide and fungicide to provide maximum protection for all plant materials.
 - b. Two applications (during growing season) of chemical contact spray (Round-up by Monsanto, or approved equal).
 - c. Two days per month (every two weeks) manual weeding (by hand) during the period from March 1 through September 30; remove all visible weeds.
 8. Mulching:
 - a. Keep planting areas neat and uniformly mulched as specified.
 - b. In addition to replacing and respraying mulch as necessitated during the maintenance period, completely replenish mulch in all planting areas one time (*during the last month of the One-Year Guarantee Period or as directed by the Landscape Architect).
 9. Straightening:
 - a. Maintain plants in their stable upright position and at the proper grade by straightening and tightening staking and guying apparatus, and by other necessary means.

- b. Remove staking and guying apparatus during the last month of the one-year guarantee period or earlier if guying begins to girdle tree.
- F. Install and maintain temporary flags, signs, barricades, protection fences, and other precautions necessary to protect the Work and the general public, and as approved by the Landscape Architect.
- G. Clean-Up:
 - 1. Keep all planting areas neat, weeded and uniformly mulched on a continuous basis.
 - 2. Clean-up adjacent walks, drives and other areas where littered as a result of landscape maintenance operations, on a continuous basis.
- H. Submit request for payment monthly at end of month maintained.

3.7 SUBSTANTIAL COMPLETION, PAYMENT AND GUARANTEE

- A. Substantial Completion and Payment:
 - 1. Submit request for inspection of Substantial Completion in writing to the Landscape Architect at least one week prior to anticipated date of inspection.
 - 2. Submit Maintenance Manual as specified in 1.04 (C) for Owner's information and Landscape Architect's approval, containing full details for care and maintenance of landscape work, personnel and procedures, and weekly schedule for maintenance.
 - 3. Review the Work jointly with the Landscape Architect for Substantial Completion.
 - 4. Upon completion of repairs and replacements found necessary at time of review, the Landscape Architect will confirm the date of Substantial completion of the Work.
 - 5. Upon receipt of confirmation of Substantial Completion, Contractor will be paid amount of money then due, less the value of the Maintenance Period, amounts already paid, and other deductions allowed to be made,
 - 6. Substantial Completion constitutes the beginning date of the Maintenance Period and One-Year Guarantee Period.
- B. Basis of Acceptance:
 - 1. Planted trees, shrubs and groundcovers will be counted as individual units, complete, in place and planted in accordance with the plans and specifications. Each unit will include the installed plant, topsoil mix, mulch and staking apparatus.
 - 2. Maintenance Period will be counted as a lump sum item.
 - 3. Plant pit excavation in shot-rock (if required) will be counted as individual units. Necessity will be determined by Landscape Architect.
 - 4. The cost of mobilization (including all provisions of General Requirements and General and Supplementary Conditions), clean-up, guarantee and maintenance will Substantial Completion as specified herein are considered incidental to the Work and will not be counted as separate items for payment.
- C. Guarantee:
 - 1. Guarantee all materials and workmanship for a period of one (1) year beyond the Date of Substantial Completion.
 - 2. When Work is substantially completed in parts, the Guarantee Period extends from each Substantial Completion date to the terminal date of the last Guarantee Period. Thus, all Guarantee Periods terminate at the same time.
 - 3. During the period of the Guarantee, replace with no additional compensation, and as soon as weather permits, all dead plant materials and all plant materials not in a thriving condition; replace all other materials which are unsatisfactory in the opinion of the Landscape Architect; make good any other damage, loss destruction, or failure to flourish sufficiently as the result of inferior or defective materials or workmanship, including, but not limited to inadequate drainage.
 - 4. Repair grades and other Work necessitated due to planting replacements.
 - 5. If the replacement plant is not acceptable during or at the end of the Guarantee Period, the Owner may elect either subsequent replacement or credit.

6. Guarantee applies to losses other than those due to Act of God, vandalism, or Owner neglect, as determined by the Landscape Architect. Contractor agrees to replace such plant material at original contract price when directed by Landscape Architect or Owner.

3.8 FINAL INSPECTION AND FINAL ACCEPTANCE

- A. At the end of the Guarantee Period submit request for inspection for Final Acceptance to the Landscape Architect at least one week prior to anticipated date of inspection. Include list of Work substantially completed list of Work replaced during Guarantee Period.
- B. Upon request for Inspection, jointly review with Landscape Architect all guaranteed Work for Final Acceptance.
- C. Upon completion by the Contractor of all required repairs and replacements, the Landscape Architect will confirm the date of Final Acceptance of the Work.

END OF SECTION

SECTION 33 11 20
DOMESTIC WATER AND FIRE SERVICES

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 312335: Excavating and Backfilling
- B. Section 331300: Disinfection of Water System
- C. Section 333000: Sanitary Sewer System

1.02 SUBMITTALS

- A. Submit items under provisions of Division One.
- B. Submit manufacturers' installation instructions for pipe and fitting joints.
- C. Submit certification from the manufacturer that materials meet the standards specified herein.

1.03 QUALITY ASSURANCE

- A. Coordinate work on public property and easements with the local department of public works having jurisdiction, and comply with applicable requirements
- B. Make arrangements with the authorities having jurisdiction to connect public utilities as indicated. Pay all fees.
- C. Maintain one copy of each standard specified herein at the job site.
- D. Ensure system is not used until system has been disinfected.

1.04 RECORD DOCUMENTS

- A. Submit reproducible record drawings showing waterline construction under provisions of Division One.
- B. Have record documents certified by a land surveyor or civil engineer licensed in the state where the Project is located.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Ductile iron piping:
 - 1. Pipe and Fittings: Pipe, except flanged pipe, shall conform to AWWA C151/A21.51 and shall be Pressure Class 350 for pipe sizes 12-inch and smaller and Pressure Class 250 for pipe sizes 14-inch and larger. Flanged pipe shall conform to AWWA C115/A21.15. Fittings shall conform to AWWA C110/A21.10 or AWWA C153/A21.53. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining conforming to AWWA C104/A21.4, standard thickness.
 - 2. Joints:
 - a. Push-on type or mechanical joint shall conform to AWWA C111/A21.11.
 - b. Flanged type shall be as recommended in the appendix to AWWA C115/A21.15
 - 3. Fittings: AWWA C-110, cement-mortar lined and seal coated in accordance with AWWA C-104/A21.4, with AWWA C-111 mechanical joints.
- B. PVC piping: AWWA C-900, SDR of 18, Class 150, with ASTM D3139 bell and spigot push-on joints with ASTM F477 gaskets.
- C. Valves: AWWA C-500 resilient seated gate type with non-rising stem, 2 inch right opening (or as specified by local codes) operating nut, minimum working pressure of 200 psi, and AWWA C-111 mechanical joints.
- D. Hydrants: Mueller Centurion Model A-423 or approved equal.
- E. Marking tape: 2 inch wide utility marking tape, No. P802 Blue in accordance with AWPA Uniform Color Code.

- F. Vault:
 - 1. Frame and lid: Galvanized steel with hinged lid, stamped with the word "WATER".
 - 2. Cast-in-place concrete: 3500 psi at 28 days, as specified in Section 32 05 23.
 - 3. Precast concrete: ASTM C478, 4000 psi at 28 days.
- G. Valve boxes: In accordance with City of Lee's Summit Utilities Standards and Construction Specifications.
- H. Miscellaneous cast-in-place concrete: As specified in Section 320523, 2-4 inch slump, with 28 day compressive strengths as follows:
 - 1. Pipe encasement: 3000 psi.
 - 2. Pads and structures: 3500 psi.
- I. Tapping sleeves and valves:
 - 1. Sleeve: Split-type ductile iron with mechanical joints.
 - 2. Valve: Resilient seated gate type with non-rising stem, Class 200.
- J. Testing accessories: Pumps, connections, gauges, temporary plugs and blocking required.
- K. Substitutions: Materials of the same function and performance are acceptable under provisions of Division One.

PART 3 EXECUTION

Domestic and Fire water distribution systems shall be installed per City of Lee's Summit Utilities Standards and Construction Specifications. The contractor is responsible for obtaining a copy of the specifications from City of Lee's Summit Utilities.

3.01 PREPARATION

- A. Notify Owner's Representative and local utility district prior to installation.
- B. Layout intended work, verify burial depth and flag existing utilities. Notify the Owner's Representative of discovered discrepancies prior to installation.
- C. Verify provisions of utility separation specified herein are possible before starting installation.
- D. Verify trench has been properly excavated and bedded as specified in Section 312335.
- E. Ensure Water control in trenches and pits is maintained under provisions of Division One.
- F. Ensure water control in trenches and pits for soft or unstable materials. Where substrate is incapable of supporting piping or structures, over excavate down to solid bearing as directed by the Owner's Representative, and backfill excavation with crushed stone or gravel specified in Section 312335.

3.02 PIPE INSTALLATION

- A. Install pipe and fittings in dry trenches and pits in accordance with the manufacturer's printed instructions, with a minimum cover of 36 inches from finished grade. Maintain minimum lateral separation between waterlines and new or existing storm or sanitary sewer lines of 10 ft., measured edge to edge.
 - 1. When crossing sewers, maintain 18 inches minimum between top of sewer and bottom of waterline where possible.
 - 2. Where installation above sewers is not feasible, maintain 18 inches minimum between bottom of sewer and top of waterline, and have sewer encased in concrete for a distance of 10 ft. on each side of water main. Encase water pipe joints within 10 ft. of crossing in concrete.
 - 3. When clearance above or below sewers specified above is not possible, encase pipe in concrete as approved by the Owners Representative.
- B. Secure pipe in place with approved bedding tamped beneath haunches and along sides after each length is laid. Remove all foreign material and install suitable stoppers after each segment laid.
- C. Provide restraint joints of sizes indicated for the application at all fittings and bends or where unbalanced line thrust exists.

1. Verify suitability of soil bearing capacity. Where capacity is not suitable, install approved restraining assembly as directed by the Owners Representative.
 2. Do not cover outlets, bolts, nuts, restraint assemblies or other fittings.
- D. Torque bolts with a torque limiting wrench in accordance with AWWA C-111.
 - E. Install marking tape in all trenches containing PVC piping in accordance with the manufacturer's printed instructions.
 - F. Have trenches backfilled in accordance with Section 312335.

3.03 VALVE AND VALVE BOX INSTALLATION

- A. Set valves so that stems are plumb, and install joint restraints. Where operating nut is more than 3 ft. below finished grade, provide operating nut extensions to bring operating nut to within 12 inches below finished grade.
- B. Provide a valve box for each valve. Place so that shock and stress are not transmitted to valve. Set valve box plumb, centered over operating nut and flush with finish grade. Install concrete pad around boxes in lawn areas.

3.04 TAPPING SLEEVE INSTALLATION

- A. Only use sleeve manufactured for the specific outside diameter of main being tapped. Do not install sleeve closer than 48 inches from bell, coupling or fitting.
- B. Check saddle for leaks by low pressure testing and soap prior to making tap.
- C. Set tapping valve plumb with finished grade. Provide valve box.

3.05 HYDRANT INSTALLATION

- A. Excavate a 3 x 3 ft. drainage pit below each hydrant and fill with 3/4 inch coarse gravel or crushed stone.
- B. Install plumb, with pumper nozzle facing curb or street, to be a minimum of 18 inches from the face of the curb or edge of street with nozzles at least 16 inches above finished grade. Set so that traffic flange is no more than 6 inches nor less than 4 inches from finished grade. Provide approved hydrant extensions as required to meet elevation requirements.
- C. Connect Hydrant to water main with restrained joints, with 6 inch lateral and 6 inch gate valve.
- D. Install restraint joint at hydrant base and water main tee. Do not cover weep holes.
- E. Test for leakage upon completion.

3.06 TESTS

- A. Preparation:
 1. Notify the Owners Representative and the authority having jurisdiction at least 48 hours before testing operations are to begin.
 2. Verify restraint joints are tightened and that trenches are properly backfilled and compacted prior to testing.
- B. Pressure testing:
 1. Test ductile iron mains in accordance with AWWA C-600 and City of Lee's Summit Utilities Standards and Construction Specifications.
 2. Test PVC mains in accordance with AWWA Manual M-23 and City of Lee's Summit Utilities Standards and Construction Specifications.
 3. Test piping at 125% of working pressure or at 150 psi, whichever is greater, for a period of 2 hours. Do not vary pressure more than + 5 psi.
 4. Provide suitable air relief valves, corporation stops or other approved devices to expel air as line is filled with water.
 5. Remove and replace cracked or defective pipe, fittings and retest after replacement.
- C. Leakage testing:
 1. Test ductile iron mains in accordance with AWWA C-600 and City of Lee's Summit Utilities Standards and Construction Specifications.

2. Test PVC mains in accordance with AWWA Manual M-23 and City of Lee's Summit Utilities Standards and Construction Specifications.
 3. Leakage testing may be performed simultaneously with pressure testing.
 4. Leakage is determined from quantity of water that must be supplied to maintain test pressure after air in pipe has been expelled and pipe has been filled with water.
- D. Acceptance:
1. The system will be acceptable when able to maintain the specified minimum pressure and the maximum allowable leakage rate.
 2. Repair all visible leaks regardless of leakage amount.
 3. Repair and retest as necessary to satisfy acceptance criteria.

END OF SECTION

SECTION 33 13 00
DISINFECTION OF WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Section 331120: Domestic Water & Fire Services
- B. Disinfection of building domestic water piping system.

1.02 SUBMITTALS

- A. Submit items under provisions of Division 1 of the Specifications.
- B. Submit name of Treatment Company and evidence of qualification.
- C. Submit name of testing agency and evidence of qualification.

1.03 QUALITY ASSURANCE

- A. Company performing water treatment: Certified for disinfection by the authorities having jurisdiction, specializing in this work, with a minimum of 3 years experience.
- B. Testing agency: Certified or approved, as required by the authorities having jurisdiction, for examination of drinking water in compliance with legislation of the state where the Project is located.

1.04 REGULATORY REQUIREMENTS

- A. Comply with applicable code or regulations having jurisdiction for work of this Section.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit reports under the provision of Division 1 of the Specifications.
- B. Disinfection report: Accurately record the following:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in mg/L for each outlet tested.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in mg/L for each outlet tested.
- C. Bacteriological report: Accurately record the following:
 - 1. Date issued, project name, and testing agency name, address and telephone number.
 - 2. Time and date of water sample collection.
 - 3. Name of person collecting samples.
 - 4. Test locations
 - 5. Initial and 24 hour disinfectant residuals in mg/L for each outlet tested.
 - 6. Coliform bacteria test results for each outlet tested.
 - 7. Certification that water complies, or fails to comply, to bacterial standards of authorities having jurisdiction.
 - 8. Bacteriologist's signature.

PART 2 PRODUCTS – OMITTED

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that piping system has been cleaned, inspected and pressure tested.
- B. Perform scheduling and disinfection activity with startup, testing, adjusting and balancing, and demonstration procedures, including coordination with related systems.

3.02 EXECUTION

- A. Disinfect water distribution systems in accordance with AWWA C601 and applicable regulations of authorities having jurisdiction.
- B. Provide and attach equipment required to execute the work of this Section.
- C. Introduce treatment disinfectant into piping system at a point no more than 10 ft downstream from beginning of new main such that water will not have less than 25 mg/L free chlorine.
 - 1. Continue chlorine application until system is filled with chlorinated water and retain in main at least 24 hours to produce a minimum residual of 10 mg/L free chlorine.
 - 2. Flush and clean with municipal domestic water until chlorine residual is no more than that prevailing in the system or acceptable for domestic use.
- D. Replace permanent system devices removed for disinfection.
- E. Remove temporary system devices installed for disinfection.

3.03 TEST

- A. Provide analysis and testing of treated water under provisions of Division 1 of the Specifications.
- B. Test samples in accordance with AWWA C-601.

END OF SECTION

SECTION 33 30 00
SANITARY SEWAGE SYSTEMS

PART 1 GENERAL

1.01 RELATED WORK

- A. Section 22 14 00: Storm Drainage System
- B. Section 31 23 35: Excavating and Backfilling for Service Utilities
- C. Section 32 05 23: Site Concrete Work
- D. Building sanitary sewage piping and connection.

1.02 SUBMITTALS

- A. Submit items under provisions of Division 1 of the Specifications.
- B. Submit manufacturer's installation instructions for pipe and fitting joints.
- C. Submit manufacturer's certifications that materials meet the standards specified herein.

1.03 PROJECT RECORD DOCUMENTS

- A. Submit reproducible record drawings showing sewer construction.
- B. Accurately record location of pipe runs, connections, manholes, cleanouts, and invert elevations. Also, identify discovery of uncharted utilities.
- C. Have record documents certified by a land surveyor or civil engineer licensed in the state where the Project is located.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site and handle under provisions established in Division 1 of the Specifications.
- B. Store and protect materials under provisions established in Division 1 of Specifications.

1.05 SITE PROTECTION

- A. Protect existing utilities, sidewalks, curbs, pavements, slabs, and other structures from damage during the execution of work during this Section.
- B. When necessary to remove or relocate existing utilities or structures to execute the work of this Section, repair or replace the items under the applicable provisions of the Contract Documents.
- C. Any removal or replacement of existing facilities will be considered incidental to the scope of the work of this Section and no additional payment will be allowed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. PVC pipe: ASTM D3034, SDR 35 with ASTM D3212 bell and spigot joints and ASTM F477 rubber gaskets.
- B. Ductile iron pipe: Pipe and fittings shall conform to the requirements of ANSI 21.51/AWWA C-151. Pipe class shall be 52.
- C. Couplings for dissimilar pipe: Compression type rubber meeting test requirements of ASTM C425, Table 2.
- D. Cleanouts:
 - 1. Pipe: ASTM D3034, SDR 35 long sweep 1/4 bend or combination wye and 1/8 bend, diameter same as main.
 - 2. Cover: Cast iron by Neenah or Josam.
 - 3. Concrete: 3000 psi at 28 days, as specified in Section 32 05 23.
- E. Manholes:

1. Frame and grate: ASTM A48 Class 30 grey iron with machined surface and smooth bearing by Model USF 225-AS, or approved equal.
 2. Cast-in-place concrete: 3000 psi at 28 days, as specified in Section 32 05 23.
 3. Precast concrete: ASTM C478 4000 psi, reinforced, with preformed plastic gaskets meeting FS SS-S-00210.
 4. Brick: ASTM C32 Grade MS
 5. Mortar: ASTM C270 Type S, using ASTM C150 Type II portland cement, ASTM C33 sand and potable water
 6. Ladder bars: Aluminum alloy or No. 3 reinforced baren capsulated in polypropylene.
 7. Coal tar: Military Specification MIL-C-15203 C.
 8. Resilient connectors: ASTM C93
- F. Miscellaneous cast-in-place concrete: As specified in Section 32 05 23; 2-4 inch slump.
1. Pipe encasement: 2500 psi at 28 days.
 2. Structural: 3500 psi at 28 days.

PART 3 EXECUTION

Sanitary sewerage systems shall be installed per City of Lee's Summit Utilities Standards and Construction Specifications for sanitary sewer installation. The contractor is responsible for obtaining a copy of the specifications from City of Lee's Summit Utilities.

3.01 PREPARATION

- A. Contractor shall install system in accordance with City of Lee's Summit Utilities Standards and Construction Specifications requirements contained herein.
- B. Notify the Architect prior to installation.
- C. Layout intended work, verify installation depths and flag existing utilities. Notify the Architect of discrepancies prior to installation.
- D. Verify that trench has been properly excavated and bedding material placed in accordance with Section 31 23 35.
 1. Where trench bottoms are at incorrect elevations, excavate as necessary and place specified bedding thickness, or place additional bedding as applicable.
 2. Grade bedding to provide uniform support of pipe including allowance for pipe hubs.
- E. Ensure water control in trenches and pits is maintained under provision of Division 1 of the Specifications.
- F. Check bottom of trenches and pits for soft or unstable materials. Where substrate is incapable of supporting piping or structures, overexcavate down to solid bearing as directed by the Architect, and backfill excavation with crushed stone or gravel specified in section 31 23 35.

3.02 INSTALLATION OF PIPE

- A. Installation of PVC pipe shall conform to ASTM D-2321. Installation of ductile iron pipe shall conform to requirements of ANSI 21.10/AWWA C-110. Install in dry trenches to line and grade indicated. Employ necessary means to maintain accurate grade control. Lay pipe from downgrade to upgrade with pipe bells facing upgrade. Maintain minimum lateral separating of 10 feet between water and 5 feet between all other utilities.
 1. When crossing waterlines, maintain 18 inches minimum between top of sewer and bottom of waterline where possible.
 2. Where above clearance cannot be attained by altering grade of sewer pipe or relocation of water pipe, relocate water line below sewer with 18 inches minimum between bottom of sewer and top of waterline, and encase sewer in concrete for a distance of 10 feet on each side of crossing. Encase water pipe joints in concrete within 10 feet of crossing.
 3. If water control measures fail to maintain dry trenches, coarse granular material may be placed in trench bottoms as necessary to maintain water level below pipe invert.
- B. Assemble pipe joints and fittings in accordance with the manufacturers, printed instructions for the application.

1. Coordinate connection of service laterals to building service lines.
2. Join dissimilar pipe with approved compression couplings.
3. Connect sewer mains into existing manholes by cutting into structure at required elevation and grouting pipe to be flush with inside edge of manhole. Reconstruct invert to provide a smooth flowline. Cover sewer line with concrete capping at least 6 inches above and around sides of pipe where cover is less than 36 inches.

3.03 INSTALLATION OF MANHOLES

- A. Install in dry pits to line and grade indicated.
- B. Construct inverts of cast-in-place concrete or brick and masonry fill. Make changes in invert cross section gradually from side to side of manhole. Make changes in flow direction with true curves of as large a radius as possible.
- C. Construct manhole so that the top of the base is at the elevation of the invert of the lowest pipe entering the manhole. Install steps as required by the local utility district. Coat inside surfaces with 12 mil thickness of coal tar epoxy when required by the local utility district.
 1. Masonry and cast-in-place type: Grout inside and outside surfaces to make watertight.
 2. Precast type: Provide flexible neoprene boots in precast manholes as required by local utility district, and flexible joint sealing compound between manhole sections.
 3. Drop manholes: Construct manholes to be drop type when difference between invert elevations of two or more pipes is 24 inches or greater. Use drop pipe and fittings of the same diameter as pipe entering manholes. Support drop connection with cast-in-place concrete as required by the local utility district.

3.04 ACCEPTANCE TESTING

- A. Demonstrate that pipe and manholes are laid true to line and grade. Provide labor and equipment necessary to assist demonstration.
 1. Verify invert elevations and pipe gradients of installed items.
 2. "Lamp" lines between manholes. If lamping indicates a possibility of pipe deflection, pull an approved mandrel with a diameter of 95% of the pipe diameter from manhole to manhole. Replace sections not permitting the mandrel to pass at no additional cost.
- B. Demonstrate proper gradient of pipe segments by flooding and visual inspection.
 1. After flooding, verify water drains off so that the depth of water remaining is no greater than 1/2 inch in pipes less than 36 inches in diameter and 3/4 inch in pipe 36 inches in diameter and greater.
 2. Replace pipe segments with puddling in excess of that specified above at no additional cost.
- C. When requested by the Architect or local utility district, demonstrate that pipe and manholes are watertight by low air pressure testing, infiltration testing or exfiltration testing. Repair pipe segments or manholes failing to pass leakage test at no extra cost.
- D. The system will not be acceptable until leaks and other defects are repaired.

END OF SECTION

SECTION 33 40 00
STORM DRAINAGE SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Installation of storm drainage systems.

1.02 RELATED WORK

- A. Section 31 23 35: Excavating and Backfilling for Service Utilities.
- B. Section 32 05 23: Site Concrete Work

1.03 REGULATORY REQUIREMENTS

- A. Comply with requirements of authorities having jurisdiction for materials and installation of work of this Section.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Division 1 of the specifications.
- B. Accurately record locations of pipe runs, connections, catch basins, manholes, clean-outs and invert elevations.
- C. Identify and describe discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

- A. Reinforced concrete pipe: ASTM C76 Class III, with Wall Type B mesh reinforcement, with bell and spigot end joints, size as indicated. Provide mortar joints.
- B. PVC pipe: ASTM D3034, SDR of 35 or equal, bell and spigot type, solvent sealed end joints, size as indicated.
- C. Fittings: Same material as pipe, molded or formed to suit pipe size and end design, in configurations required.

2.02 CATCH BASINS

- A. Lid and frame: Cast iron construction, hinged lid linear grill lid design with lock down fasteners (as noted on the plans), size as indicated on plans.
- B. Shaft and cone section:
 - 1. Precast type: Reinforced precast concrete pipe sections of shape and size indicated, lipped male/female dry joints.
 - 2. Cast-in-place type: 3000 psi concrete as specified in Section 02516, detailed as indicated.
 - 3. Masonry type: ASTM C32 Grade MS manhole brick, and ASTM C270 Type S mortar made with ASTM C150. Type II Portland cement, ASTM C33 sand and potable water.
- C. Base pad: 3000 psi concrete of type specified in Section 32 05 23, leveled top surface to receive concrete shaft sections, and sleeved to receive pipe sections.
- D. Advanced Drainage Systems (ADS) or National Diversified Sales, Inc. (NDS) plastic catch basins and fittings.

2.03 MANHOLES AND CLEANOUTS

- A. Lid and frame: Cast iron construction, with removable lockable closed lid, size as indicated on plans.
- B. Shaft and cone section:
 - 1. Reinforced precast concrete pipe sections of shape and size indicated, with lipped male/female dry joints.

2. Cast-in-place type: 3000 psi concrete as specified in Section 32 05 23, detailed as indicated.
 3. Masonry type: ASTM C32 Grade MS manhole brick, and ASTM C270 Type S mortar made with ASTM C150. Type II Portland cement, ASTM C33 sand and potable water.
 4. Ladder rungs: 1/2 inch diameter deformed reinforcing steel, grade 60 standards coated with High Impact Copolymer Polypropylene. Step to be placed at 12 inches oc.
- C. Base pad: 3000 psi concrete of type specified in Section 32 05 23, leveled top surface to receive concrete shaft sections, and sleeved to receive pipe sections.

2.04 HEADWALLS

- A. Materials: 3000 psi concrete as specified in Section 32 05 23, reinforced as indicated.

2.05 AGGREGATE BACKFILL

- A. Materials: ASTM C33 No. 57 aggregate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavation is ready to receive work of this Section, and that excavation's, dimensions and elevations are as indicated on the Drawings.
- B. Do not install drainage structure until mass grading has resulted in rough subgrade elevations through the work area.

3.02 PREPARATION

- A. Prior to laying pipe, prepare suitable bedding according to Section 31 23 35.
- B. Before placing pipe in the trench, field inspect for cracks or other defects; remove defective pipe from the construction site.
- C. Swab the interior of the pipe to remove all undesirable material.

Prepare the bell end and remove undesirable material from the gasket and gasket recess.

3.03 INSTALLING STORM SEWER PIPE

- A. Lay pipe in a straight line on a uniform grade from structure to structure with the bell or groove end upgrade.
- B. Firmly support each section throughout its length and form a close concentric joint with the adjoining pipe.
- C. Make junctions and turns with standard or special fittings.
- D. Do not open up more trench at any time than pumping facilities are able to dewater.
- E. Whenever the work ceases, close the end of the pipe with a tight fitting plug or cover.
- F. Close all openings provided for future use and abandoned pipe with a tight fitting plug sealed to avoid leakage.
- G. When the pipe connects with structures, the exposed ends shall be placed or cut off flush with the interior face of the structure and satisfactory connections made.
- H. Any pipe which is not in good alignment or which shows any undue settlement or damage shall be taken up and re-laid without additional compensation.
- I. Laying pipe and sealing joints shall be a continuous operation.
1. Seal all joints during the same day in which the pipe is laid.
 2. Construct the joints in such a manner that a watertight joint will result.
- J. Joints for rigid pipe:
1. Rubber gaskets; or
 2. Other types of joints recommended by the pipe manufacturer and approved.
- K. Install rubber ring gaskets to form a flexible watertight seal.

- L. When other type joints are permitted, install or construct in accordance with the recommendations of the manufacturer.
- M. Firmly join flexible pipe by approved coupling bands.
- N. Inspect the pipe before any backfill is placed.
- O. When strutting or vertical elongation is required, it shall be performed in accordance with the details shown on the Plans.
- P. Leave ties and struts in place until the embankment is completed, unless otherwise specified.
- Q. As the work progresses, clean the interior of all pipe in place.
- R. Make connections by constructing catchbasins, other structures, or by installing wyes or tees as shown on the Plans. Wyes and tees for future connections shall be installed as indicated.

3.04 INSTALLING CATCH BASINS, MANHOLES AND CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for pipe end sections.
- C. Establish elevations and pipe inverts for inlets and outlets as indicated. The shape of the inverts shall conform uniformly to inlet and outlet pipe with a smooth finish.
- D. Mount lid and frame level in grout, secured to top cone section to elevations indicated. Set true to line and grade and such that the entire surface of the casting is in contact with the bearing surface of the structure.
- E. All castings shall be set firm and snug and shall not rattle.

3.05 INSTALLING HEADWALLS

- A. Form and reinforce as indicated.
- B. Place and cure as specified in 32 05 23.
- C. Backfill with aggregate to level of adjacent subgrade.

3.06 FIELD QUALITY CONTROL

- A. Prior to placing aggregate cover, allow the Owner's Representative to observe installed pipe.
- B. Comply with requirements of authorities having jurisdiction for their requirements for inspection.

3.07 PROTECTION

- A. Protect finished installation under provisions of Division 1 of the Specifications.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION