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Volume 2 of 2

2100 NW Lowenstein Rd
Lee Summit, Missouri 64081

PROJECT MANUAL

TR,i Project No.: 20-001

Date: July 15, 2021

TRi
Architects of the Possible℠

SECTION 211300 - FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The design and installation of a hydraulically calculated automatic system complete and ready for operation for portions of the buildings noted on the architectural code plan. No piping shall be located outside the heated envelope or in the attic unless a dry type system. Laying insulation over piping is not considered within the heated envelope. Balconies, breezeways and other similar locations to be served with dry system or freezeproof heads if constructed properly. No added soffits allowed in units.

1.2 QUALITY ASSURANCE

A. Installer Reliability: The installer shall possess a valid contractor's license. The installer shall have been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past three years.

B. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL, FM, or other nationally recognized testing laboratory for the specific purpose for which it is used. All materials, devices, and equipment shall be approved by the Engineer.

C. Submittals: Submit as one package. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer practicing in the field of Fire Protection Engineering. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide index referencing the appropriate specification section. Submittals shall include, but not be limited to, the following:

1. Qualifications
   a. Provide a copy of the installing contractor’s license.
   b. Provide a copy of the NICET certification for the NICET Level III or Level IV Sprinkler Technician who prepared and signed the detailed working drawings unless the drawings are stamped by a Registered Professional Engineer practicing in the field of Fire Protection Engineering.
2. Drawings: Submit scale working drawings conforming to NFPA. Include a site plan showing the piping to the water supply test location.
3. Manufacturers Data Sheets: Provide for materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.
4. Calculation Sheets: Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of NFPA.

5. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in the specification. Submittals shall include, but not be limited to, the following:
   a. One complete set of reproducible as-built drawings showing the installed system with the specific interconnections between the waterflow switch or pressure switch and the fire alarm equipment.
   b. Complete, simple, understandable, step-by-step, testing instructions giving recommended and required testing frequency of all equipment, methods for testing all equipment, and a complete trouble shooting manual. Provide maintenance instructions on replacing any components of the system including internal parts, periodic cleaning and adjustment of the equipment and components with information as to the address and telephone number of both the manufacturer and the local supplier of each item.
   c. Material and Testing Certificate: Upon completion of the sprinkler system installation or any partial section of the system, including testing and flushing, provide a copy of a completed Material and Testing Certificate as indicated in NFPA.
   d. Certificates shall document all parts of the installation.
   e. Instruction Manual: Provide one copy of the instruction manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser.

D. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA. Recommendations in appendices shall be treated as requirements.

1. Perform hydraulic calculations in accordance with NFPA utilizing the Area/Density method. Do not restrict design area reductions permitted for using quick response sprinklers throughout by the required use of standard response sprinklers in the areas identified in this section.
2. Sprinkler Protection: To determining spacing and sizing, apply the following coverage classifications:
   a. Light Hazard Occupancies: Housing, educational, office, and customary access areas.
   b. Ordinary Hazard Group 1 Occupancies: Mechanical Equipment Rooms, Electrical Switchgear Rooms, and Electric Closets.
   c. Ordinary Hazard Group 2 Occupancies: Storage rooms, kitchens, and kitchen storage areas.
   d. Verify all classifications with NFPA and AHJ.
3. Hydraulic Calculations: Calculated demand including hose stream requirements shall fall no less than 10 percent below the available water supply curve.
4. Water Supply: Base water supply on a current flow test.
5. Zoning:
   a. For each sprinkler zone provide a control valve, flow switch and a test and drain assembly with pressure gauge.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extend referenced. The publications are referenced in the text by the basic designation only.

B. National Fire Protection Association (NFPA):

13, 13R - Installation of Sprinkler Systems
101 - Safety to Life from Fire in Buildings and Structures (Life Safety Code)
170 - Fire Safety Symbols

C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment Directory – 2001

D. Factory Mutual Engineering Corporation (FM): Approval Guide

PART 2 - PRODUCTS

2.1 PIPING & FITTINGS

A. Provide sprinkler systems pipe and fittings in accordance with NFPA and U.L. / F.M. listed for use. Use minimum Schedule 10 black steel with 1 ¼" and above for grooved pipe and Schedule 40 black steel for screwed pipe.

B. Piping from the exterior main into the building shall be ductile iron with mechanical joints.

C. CPVC piping per ASTM F442 / F442M, U.L. 1821 may be used only in residential areas where allowed by AHJ, NFPA and manufacturer's listing. Retail/commercial areas shall be black steel. Pipe shall be clearly marked as "listed" and "CPVC sprinkler pipe". Fitting shall be socket type and be U.L. listed and/or FM approved and marked thus. Provide CPVC-to-metal transitions and unions as threaded brass to socket-end.

2.2 VALVES

A. Valves in accordance with NFPA.

B. Do not use quarter turn ball valves for (2 inch) or larger drain valves.

C. Alarm check valve variable pressure type with retarding chamber. Provide basic trimmings for alarm test by-pass, gauges, drain connections, pressure sensitive alarm switch to actuate the fire alarm system.

2.3 FIRE DEPARTMENT SIAMESE CONNECTION

A. Brass, flush wall type, and a minimum of two (2-1/2 inch) connections threaded to match those on the local fire protection service, with polished brass caps and chains. Provide escutcheon with integral raised letters "Automatic Sprinkler". Install an automatic ball drip between fire department connection and check valve with drain piping routed to the exterior of the building or a floor drain.

2.4 SPRINKLERS

A. Type: Sprinklers shall be UL and/or FM approved. Provide quick response sprinklers in all areas, except where specifically prohibited by their listing or approval. Provide white escutcheons, semi-recessed type in finished areas.

2.5 SPRINKLER CABINET

A. Provide sprinkler cabinet with the required number of sprinkler heads of all ratings and types installed, and a sprinkler wrench for each system. Locate adjacent to the riser.

2.6 IDENTIFICATION SIGNS/HYDRAULIC PLACARDS

A. Plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Enter pertinent data for each system on the hydraulic placard.

2.7 SWITCHES

A. Contain in a weatherproof die cast/red baked enamel, oil resistant, aluminum housing with tamper resistant screws, (1/2 inch) conduit entrance and necessary facilities for attachment to the valves. Provide two SPDT switches rated at 2.5 amps at 24 VDC.

B. Waterflow Alarm Switches: Mechanical, non-coded, non-accumulative retard and adjustable from 0 to 60 seconds minimum. Set flow switches at an initial setting between 20 and 30 seconds.

C. Valve Supervisory Switches for Ball and Butterfly Valves: May be integral with the valve.

2.8 GAUGES

A. Provide gauges as required by NFPA.

2.9 PIPE SUPPORTS

A. Supports, hangers, etc., of an approved pattern placement to conform to NFPA.

2.10 WALL, FLOOR AND CEILING PLATES

A. Provide plated steel escutcheon plates for exposed piping passing though walls, floors or ceilings chrome.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.

B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situations where bending of the pipe is required, use a standard pipe-bending template. Install concealed piping in spaces that have finished ceilings. Locate piping in stairways as near to the ceiling as possible to prevent tampering by unauthorized personnel. To prevent an obstruction to egress, provide piping clearances in accordance with NFPA 101.

C. Welding: Conform to the requirements and recommendations of NFPA.

D. Drains: Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA.

E. Supervisory Switches: Provide supervisory switches for sprinkler and standpipe control valves. Do not provide standpipe hose valves and test and drain valves with supervisory switches.

F. Waterflow Alarm Switches: Install waterflow switch and adjacent valves in easily accessible locations.

G. Inspector's Test Connection: Install and supply in conformance with NFPA, locate in a secured area, and discharge to the exterior of the building.

H. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA. Seal this space with a UL Listed through penetration fire stop material in accordance with the specifications. Where core drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls, floors and ceilings of other types of construction.

I. Provide pressure gauge at each water flow alarm switch location, at the top of each standpipe, and at each main drain connection.

J. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.

3.2 INSPECTION AND TEST

A. Preliminary Testing: Hydrostatically test system, including the fire department connections, as specified in NFPA. Test and flush underground water line prior to performing these hydrostatic tests.

B. Final Inspection and Testing: Subject system to tests in accordance with NFPA, and when all necessary corrections have been accomplished, advise Architect/Owner to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.

END OF SECTION 211300

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

A. All contract documents including drawings, alternates, addenda, and modifications in addition to this specification are applicable to the Plumbing Contractor (P/C) and his Subcontractors, and material suppliers.

B. Engineer, wherever used in the specifications, shall mean Latimer Sommers & Associates, P.A., 3639 S.W. Summerfield Dr., Topeka, KS 66614, 785-233-3232, lsapa@lsapa.com.

C. Contractor, wherever used in these specifications, shall mean the company that enters into contract with the General Contractor or Owner to perform this section of work.

D. When a word such as “proper”, “satisfactory”’ “equivalent”, and “as directed”, is used, it requires Engineer’s review. “Provide” means furnish, install, and commission.

E. Changes or deviations from the contract, including those for additional work, must be submitted in writing for review by the Engineer.

F. If conflicts or ambiguities are present between the drawings and specifications, the contractor shall contact the Engineer for clarification. If no resolution is made by the Engineer via an addendum, the more costly option shall be included in the contract. Contractor shall notify Engineer as soon as possible for a resolution.

G. Do not scale plumbing drawings for dimensions. Accurately lay-out work from dimensions indicated on Architectural drawings unless such is found in error.

H. Items not shown on the drawings or in the specifications, but reasonably inferred from the documents shall be included in the contract.

I. Contractor may be allowed access to the CAD drawings files produced by the Engineer upon written release and payment of charges.

1.2 LOCATIONS AND INTERFERENCES

A. Contractor shall visit site to determine existing site conditions that affect the contracted work.

B. Locations of equipment, piping and other mechanical work are indicated diagrammatically by the drawings. Determine exact locations on site, subject to structural conditions, work of other Contractors, access requirements for installation and maintenance to the approval of the Engineer.

C. Study and become familiar with the contract drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for installation. Cooperate with other contractors and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Engineer. Failure of contractor to coordinate with other trades prior to construction is not cause for additional compensation.

D. Any pipe, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed and if so shown, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, the Subcontractor, or workers shall be restored as specified for new work.

1.3 QUALITY ASSURANCE

A. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions.
2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 100 miles of the project. These organizations shall come to the site and provide acceptable service to restore operations within 24 hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 48 hours in a non-emergency. Submit names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, critical instrumentation, computer workstation and programming.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
5. Asbestos products or equipment or materials containing asbestos shall not be used.
6. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

B. Warranty

1. Contractor warrants to Owner and Architect the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of mechanical systems by Owner.

2. Contractor warrants to Owner and Architect that on receipt of written notice from either of them within one-year warranty period following date of acceptance that defects have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor's expense.
3. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, install equipment or accessories per these instructions including all items needed to fulfill these requirements. Any discrepancy between these instructions, Code, and the contract documents shall be brought to the attention of the Engineer for interpretation. Installation shall meet manufacturer's recommended clearances. Any conflicts shall be brought to the attention of the Engineer prior to installation.

D. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

1.4 MATERIALS, EQUIPMENT, AND SUBSTITUTIONS

A. The intent of these specifications is to allow competition in bidding on standards of materials and equipment required.

B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage unless shown otherwise on the drawings.

C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product may be used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.

D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.

E. Prior to receipt of bids, if contractor wishes to incorporate products other than those named in specifications in his base bid, he shall submit a written request for review of substitutions to Engineer not less than five working days prior to bid time. Engineer may review requests and acceptable items will be listed in an addendum issued to principal bidders.

F. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical

size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison. Differences between specified and submitted items shall be listed by the supplier/contractor and included with the submittal.

G. In proposing a substitution prior to or subsequent to receipt of bids, include in such proposal cost of altering other elements of project, including adjustments in mechanical electrical service requirements necessary to accommodate such substitution; whether such affected elements to this contract or under separate contracts.

1.5 SUBMITTALS

A. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Information shall be clearly marked as to individual model to be provided on this project. Do not submit operations manuals, installation guides, wiring diagrams, or other voluminous documents unless requested by Engineer. If the Contractor feels these items are pertinent in the review, prior approval shall be obtained from the Engineer. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been reviewed, no change in brand or make will be permitted unless approved by the Engineer.

B. Engineer may review submittals only as a courtesy to the contractor. Contractor has the obligation to provide items/work in the contract documents or reasonably inferred and this includes the project schedule. The lack of comments, notes, or other indications made by the Engineer on a submittal does not relieve the contractor from providing the necessary items/work. Review by the Engineer does not constitute “approval” of items submitted. Engineer will not check quantities, dimensions, etc. for accuracy or appropriateness.

C. Forward submittals in sufficient time to permit proper consideration by the Engineer. Provide submission to assure adequate lead time for procurement. Delays attributable to untimely and rejected submittals will not serve as a basis for extending contract time for completion. Engineer shall endeavor to review submittals in two weeks.

D. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor and shall contain the list of items, name of project, name of Contractor, supplier and their contact numbers, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, submittals shall be marked to indicate specific items submitted for approval. Submittal shall bear the General and Sub-Contractor’s approval stamp indicating they have reviewed the submittal for conformance to the contract documents.

E. Where required by these specifications, the drawings, or the Engineer, provide scaled shop drawings of the piping systems and/or equipment to reflect actual routing, location, coordination with other trades and structure, and maintenance accessibility. Review with Engineer scope of the documents prior to submission.

F. Upon request of the Engineer, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.

1.6 OPERATIONS AND MAINTENANCE MANUALS

A. Submit two copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Instructions shall be prepared by equipment manufacturer.

B. Present to Owner, keys and wrenches furnished with equipment under this contract and obtain receipt for same upon completion of project.

C. Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to Architect-Engineer for review before delivery to Owner. Provide brochures bound in three-ring binders with metal hinge. Clearly print project and section covered on label insert of each brochure. Brochures shall contain following:

1. Certified equipment drawings/or catalog data with equipment provided clearly marked.
2. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
3. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of mechanical system.
4. A complete set of as-built drawings to scale showing all mechanical systems as installed.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage. This shall include any existing, relocated or owner-furnished equipment/systems.
2. Place damaged equipment in first class, new operating condition; or replace same as determined and directed by the Engineer. Such repair or replacement shall be at no additional cost to the Owner.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before installing or placing equipment in operation.

4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or cleaned as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.8 SAFETY AND SECURITY

A. Contractor shall follow OSHA safety regulations while on site and have an OSHA-trained individual on site at all times.

B. Contractor shall follow Owner's safety and security regulations with regards to identification, keys and access, document control, motor vehicles, firearms, illegal substances, smoking, etc as per the Owner's request.

C. Contractor shall follow fire safety rules per OSHA and NFPA standards regarding temporary facilities, maintaining fire exiting, fire suppression and alarm systems, hot work, storage, utilities, etc.

1.9 DISPOSAL AND RETENTION

A. Waste materials, including those considered hazardous, accrued from the construction process shall be removed promptly from the project site in a manner approved by the authorities having jurisdiction.

B. Verify with the owner any items that may be retained by the owner for future use or salvage prior to removal.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be products of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.

4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

B. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

C. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.3 SAFETY GUARDS

A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with adequate bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

2.4 LIFTING ATTACHMENTS

A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.5 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING

A. All material and equipment furnished and installation methods shall conform to the requirements of other sections of this specification. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient motors as scheduled. Unless otherwise specified for a particular application use electric motors with the following requirements.

B. Special Requirements:

1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the owner.
2. Assemblies of motors, starters, controls, and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.

3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
   a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers or heaters.
   b. Other wiring at boilers or heaters and to control panels shall be NFPA 70 designation THWN.
   c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.
4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
5. Motors utilized with variable frequency drives shall be rated “inverter-ready” per NEMA Standard, MG1, Part 31.4.4.2.

C. Motor Efficiency and Power Factor: All motors, when specified as “high efficiency” by the project specifications on driven equipment, shall conform to efficiency and power factor requirements generally defined by motor manufacturers as “NEMA premium efficient” and the requirements generally exceed those of the Energy Policy Act of 1992 (EPACT). Motors not specified as “high efficiency” shall comply with EPACT.

D. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC).

E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

F. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees centigrade (104 degrees F); minimum horsepower as shown on drawings; maximum horsepower in normal operation not to exceed nameplate rating without service factor.

G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

2.6 ELECTRICAL REQUIREMENTS

A. Electrical work required to install and control plumbing equipment which is not shown on plans or specified under sections in series 26000 shall be included in P/C's base bid proposal.

B. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which was not used for basis of design shall be paid for by P/C at no cost to Owner or A/E.

C. P/C shall be responsible for providing supervision to E/C to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.

D. P/C shall be responsible for providing supervision to E/C to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.

E. Furnish complete sets of electrical wiring diagrams to A/E and to E/C. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by E/C shall be clearly indicated by notation and drawing symbols on wiring diagrams.

F. Safety disconnect switches and manual and magnetic motor starters shall be provided by the P/C where not provided by the E/C per the drawings.

2.7 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals.

B. Equipment: Engraved phenolic nameplates, with letters not less than 48 mm (3/16-inch) high with white-filled letters permanently fastened to the non-apartment unit equipment.

C. Valve Tags and Lists:

1. Plumbing: Provide for all valves (Fixture stops not included) in non-apartment applications.
2. Valve tags: Engraved black filled numbers and letters not less than 1/2 -inch high for number designation, and not less than 1/4-inch for service designation, 1-1/2 inches round brass disc, attached with brass "S" hook or brass chain.
3. Valve lists: Typed or printed plastic coated 8 ½ x 11 card(s) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve.

2.8 FIRESTOPPING

A. Provide an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping with a U.L. listed firestop material and in a U.L. listed assembly configuration. Submit material and assembly detail for review.

2.9 TOOLS AND LUBRICANTS

A. Furnish, and turn over to the Owner, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

C. Lubricants: A minimum of one quart of oil, and one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Coordinate location of piping, sleeves, inserts, hangers, and equipment, access provisions, and work of all trades. Locate piping, sleeves, inserts, hangers, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.

C. Cutting Holes:

1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed.
2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by A/E.
3. Do not penetrate membrane waterproofing.

D. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown, but must be provided.

E. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

F. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Engineer. Damaged or defective items in the opinion of the t Engineer, shall be replaced.
2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury.

G. Concrete and Grout: Use concrete and shrink compensating grout 3000 psi minimum.

H. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

I. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.

J. Inaccessible Equipment:

1. Where the A/E determines that the P/C has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.

B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities.

C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

D. All temporary shut-downs of service shall be coordinated with the owner and other trades as needed to maintain operating service in the facility. Off-hours work is normally needed to accomplish these and shall be included in the contract.

3.3 RIGGING

A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.

B. Alternative methods of equipment delivery may be offered by P/C and will be considered by A/E under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.

C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for operation and maintenance of service.

D. P/C shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.

3.4 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Owner, equipment and systems shall be thoroughly cleaned and painted.

B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
2. Material and equipment not to be painted includes:
   a. Motors, controllers, control switches, and safety switches.
   b. Control and interlock devices.
   c. Regulators.
   d. Pressure reducing valves.
   e. Control valves and thermostatic elements.
   f. Lubrication devices and grease fittings.
   g. Copper, brass, aluminum, stainless steel and bronze surfaces.
   h. Valve stems and rotating shafts.
   i. Pressure gauges and thermometers.
   j. Glass.
   k. Name plates.
3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
6. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

3.5 STARTUP AND TEMPORARY OPERATION

A. Start up equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

END OF SECTION 220500

SECTION 220700 - PIPING AND EQUIPMENT INSULATION

PART 1 - GENERAL (Reference Section 15010)

1.1 GENERAL REQUIREMENTS

A. Provide necessary materials and accessories for installation of insulation for plumbing and mechanical systems as specified and/or detailed on drawings insulation type, jacket, and thickness for specific piping systems or equipment shall be as listed in insulation schedule.

B. Provide insulation materials manufactured by Armstrong Cork Co. Certain/Teed Saint Gobain, Dow Chemical, Schuller or Owen-Corning Fiberglass.

C. Insulation, except where specified otherwise, shall have composite fire and smoke hazard ratings as rested by ASTM E-84, NFPA 255, and UL 723 procedures not exceeding:

FLAME SPREAD	25
SMOKE DEVELOPED	50
FUEL CONTRIBUTED	50

Provide insulation accessories such as adhesives, mastics, cements, tape and glass fabric with same component ratings as listed above. Products or their shipping cartons shall bear label indicating their flame and smoke safety shall be permanent. Use of water soluble treatments such as corn paste or wheat paste is prohibited. This does not exclude approved lagging adhesives.

D. Install insulation over clean dry surfaces with joints firmly butted together. Insulation at equipment, flanges, fittings, etc. shall have straight edges with box type joints with corner beads as required. Where plumbing and heating insulation terminates at equipment or unions, taper insulation at 30 degree angle to pipe with one coat finishing cement and finish same as fittings. Total insulation system shall have neat smooth appearance with no wrinkles, or folds in jackets, joint strips or fitting covers.

E. Undamaged insulation systems on cold surface piping and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration of insulation or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.

F. Insulation of removable heads, manholes access covers, etc., shall be fabricated to allow removal without damage to insulation. Provide removable units with vapor-proof cover fabricated to be sealed to equipment vapor barrier.

G. Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season,

whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at Mechanical Contractors expense at no cost to owner.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS AND APPLICATION METHODS (PIPING)

A. Pipe insulation by type shall be as follows:

1. Type 1-PC: Insulation for cold surface equipment insulation for external surfaces with +40 degrees F to +220 degrees F operating temperature range shall be Armstrong FR/Armaflex pipe or sheet insulation as required with 5.5" or 6.0 lb. density. Average thermal conductivity shall not exceed .27 BTU/HR at 75 F mean temperature. Apply insulation directly to metal surfaces and seal insulation joints with Armstrong No. 520. Insulation shall be mitered, beveled and built-up as required to provide a smooth and neat exterior surface. Insulate these joint areas so that insulation can be easily removed from casing joints without removing or damaging adjacent insulation.

2. TYPE 1-PHC: Insulation for hot and cold surface piping systems with +40 degrees F to +450 degrees F operating range shall be Owens-Corning Fiberglass 25, 4.0 lb. density pipe insulation with white fire retardant ASJ jacket. Average thermal conductivity shall not exceed .26 BTU/Hr. at 75 degrees F mean temperature. Seal longitudinal jacket laps and butt strips with C.M. No. 17-465 or B.F. No. 85-75 vapor barrier adhesive. Insulate valves and fittings as follows:
   a. Insulate exposed and concealed valves and fittings with 2" thick glass fiberglass inserts or blankets. Cover fittings with Zeston Products PVC fitting covers or approved equal. PVC fitting covers shall be secured with mechanical fasteners such as tacks or staples for temperatures above 75 degrees F. For cold service all joints shall be sealed with vapor barrier adhesive or by pressure sensitive vapor barrier vinyl tape.

2.2 INSULATION MATERIALS AND APPLICATION METHODS (HANGERS, SUPPORTS, ANCHORS, GUIDES, EXPANSION JOINTS, ETC.)

A. Insulation materials and application methods for piping hangers supports, anchors, guides expansion joints, etc., shall be as follows:

1. Insulate hangers and supports from direct contact with 3" and above piping with Styrofoam HD-300 plastic foam inserts of half or full sections. Provide inserts with vapor barrier jacket for lapping 2" over adjoining insulation. Insert jacket shall be equal in performance and appearance to adjacent pipe insulation jacket. On 1-1/4" to 2-1/2" piping protect insulation with properly sized wood dowels cut within insulation. 1" pipe and below needs no inserts. Seal joints with vapor barrier sealer specified for insulation type used.
2. Where piping hanger cannot be isolated from cold pipe surfaces insulate piping at hanger locations with extra thickness of pipe insulation. Insulate hanger rod to point

12" above pipe with minimum insulation thickness equal to one-half thickness of pipe insulation. Seal and finish joints with vapor barrier sealer for insulation type used.

2.3 PIPE AND VALVE INSULATION SCHEDULE

SYSTEM	SIZE	TYPE	THICKNESS
HW below slab	All	1-PHC	½”

Note: No piping shall be located in attics or other unconditioned areas.

END OF SECTION 220700

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SECTION 221100 - PLUMBING PIPING, EQUIPMENT AND ACCESSORIES

PART 1 - GENERAL (Not Applicable)

PART 2 - PRODUCTS

2.1 PIPING MATERIALS AND FITTINGS

A. Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturers name and weight. All materials listed may not be required on this project. Piping materials shall be as follows:

1. Copper Tube:
   a. Provide hard temper copper water tube conforming to requirements of current ASTM Specification B-88. Tubing shall be Type K, L, or M as listed in schedule.
   b. Tubing joints shall be soldered or brazed. See schedule for joining method to be used.
   c. Pipe by Anaconda, Cerro, Chase, Mueller or Revere Copper.
2. PVC Pipe:
   a. Below grade/exterior pipe and fittings shall be ABS solid wall pipe extra strength conforming to ASTM D2661, F628
   b. Below slab pipe and fittings shall be PVC-DWV conforming to ASTM D-2665.
   c. Above grade pipe and fittings shall meet schedule 40 PVC ASTM D-2665 standards or cellular core PVC conforming to ASTM F1488. Provide cast iron where in the ceiling areas of the commercial or amenity areas..
   d. Provide socket fittings meeting ASTM D2665 and solvent meeting D2564.
3. Cross-Linked Polyethylene:
   a. Provide piping conforming to ASTM F 877-97 and F877-96a with compression fittings per ASTM F 1807-97.
4. Carbon Steel Pipe (1/2" thru 2"):
   a. Provide seamless carbon steel conforming to ASTM specification A-106 scheduled.
   b. Pipe joints shall be threaded conforming to ANSI Standard B2.1.
   c. Pipe ends shall be beveled for welding.
   d. Pipe by Armco, Jones and Laughlin Steel Corp., Youngstown Sheet and Tube Co., or United States Steel.
5. Carbon Steel Pipe (2-1/2" and above):
   a. Provide furnace butt-welded carbon steel pipe conforming to ASTM Specification A-53.
   b. Pipe ends shall be beveled for welding.
   c. Pipe by Armco, Jones and Laughlin Steel Corp., Youngstown Sheet and Tube Co., or United States Steel.
6. CPVC Pipe:
   a. Provide CPVC plastic pipe and tubing meeting ASTM D2846, F441 for 2” and below.

b. For 2 ½" and larger provide CPVC (Corzan) Sc. 40 meeting ASTM D-1784.
c. Fittings shall be matching CPVC meeting ASTM F437, 438.

2.2 PIPE SCHEDULE

SYSTEM	SIZE	TYPE	FITTINGS	DURATION
Condensate Drain	All	Sch. 40 PVC	PVC-DWV	---
Dom. Water	<2"	PEX/CPVC	Compression	150 psi/1 hr.
Dom. Water	2" and Above	CPVC-Sch 40	Solvent	150 psi/1 hr
Waste/Vent	All	Sch. 40 PVC	PVC-DWV	10 ft./1/2 hr.
Refrigerant	All	Copper	Silver solder	400 psi/1hr

2.3 VALVES

A. General

1. Provide necessary valves within piping systems to provide required flow control and to allow isolation for inspection, maintenance and repair of each piece of equipment or fixture, and on each main and branch service loop.
2. Valves installed in piping systems shall be compatible with system maximum test pressure, pipe materials, pipe joining method, and fluid or gas conveyed in system.
3. Each valve shall be installed so that it is easily accessible for operation, visual inspection, and maintenance.
4. Equivalent valves listed on current comparison charts of specified valve manufacturers by Apollo, Crane, Nibco, Dyna Quip, Keystone, Milwaukee, Griswold, Nexus are acceptable.

B. Ball Valves

1. Ball valves shall be scheduled as type "BLV" valves. Valve specifications by type number shall be as follows:

BLV-1 2-1/2" valves and smaller, Apollo bronze full port ball valve 150PSI-SWP, teflon seats, chrome plated ball, blowout proof stem, silicon bronze stem, with end connections compatible to PEX or CPVC as per application.

C. Balancing Valves

1. Balancing valves shall be scheduled as Type "BAV" valves. All balancing valves may be installed on the return or supply side of coils and shall be line sized. Provide proper sized valves for the specified flows. Provide strainers at all valves. Valve specification by type number shall be as follows:

BAV-1 3/4" thru 2 1/2": Flow Design Inc. model AC automatic type of forged brass with ball valve, flow cartridge, 400 PSIG at 250oF rating and sweat or screw connections as required.

D. Check Valves

1. Silent check valves shall be scheduled as Type "SCV" valves. Valve specifications by type number shall be as follows:

SCV-1 2" valves and smaller Stockham Fig. No. B-310T or B-320T bronze check valve, 125 PSI-WOG, spring, brass stem, teflon disc and seat ring, screwed or solder ends as required.

SCV-2 2-1/2" and larger Muessco #101-DT iron body stainless steel trim check valve 150 PSI-ASA with flanged ends.

E. Butterfly Valves

1. Butterfly valves shall be scheduled as Type "BFV" valves. Valve specifications by type number shall be as follows:

BFV-1 3" thru 6", Nibco #LD-200, 200 PSI ductile iron drilled lug body, lever operator aluminum/bronze disc, type 416 stainless steel stem and EPDM sleeve valve shall be bubble tight and designed for dead end service.

F. Valve Schedule

SYSTEM	SIZE	STOP	CHECK	BALANCE
Domestic Water	1/2"-2"	BLV-1	SCV-1	BAV-1
Domestic Water	2 ½"	BLV-1	SCV-2	BAV-1
Domestic Water	3" & Up	BFV-1	SCV-2	BAV-2

2.4 PIPE SLEEVES AND SEALS

A. Furnish proper type and size pipe sleeves to General Contractor for installation in concrete or masonry walls or floors. Sleeves are not required for supply and waste piping through wall supporting plumbing fixtures or for cast iron soil pipe passing through concrete slab or grade except where penetrating a membrane waterproof floor. Mechanical Contractor shall supervise installation of sleeves to insure proper location and installation.

B. Each sleeve shall be continuous through wall floor or roof and shall be cut flush on each side except where indicated otherwise. Sleeves shall not be installed in structural member except where indicated or approved.

C. Pipe insulation shall run continuous through pipe sleeves with 1/4" minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing through fire walls, floors and smoke partitions. Jacket shall be 0.018 stainless steel extending 12 inches on either side of barrier and secured to insulation with 3/8" wide band. Seal annular space between jacket and pipe sleeves with Thunderline High Temperature Link Seal.

D. Provide pipes passing through roof of floor waterproof membranes with flashing sleeve. Seal pipe to sleeve with fire caulk.

E. Where piping passes through walls serving as supply or exhaust air plenums or chases, seal annular space between pipe and sleeve air tight with caulk; fire rated if appropriate.

2.5 PIPE HANGERS AND SUPPORTS

A. Provide and be responsible for locations of piping hangers, supports and inserts, etc., required for installation of piping under this contract. Design of hangers and supports shall conform to industry standard, manufacturer's recommendations and City Code. Contractor to submit.

B. Pipe hangers shall be capable of supporting piping in all conditions of operation. They shall allow free expansion and contraction of piping, and prevent excessive stress resulting from transferred weight induced into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.

C. Where horizontal piping movements are such that hanger rod angularity from vertical is greater than 4 degrees from cold to hot position of pipe, offset hanger, pipe, and structural attachments to that rod is vertical in hot position. Hangers shall not become disengaged by movements of supported pipe.

D. Provide sufficient hangers to adequately support piping system at specified spacing, at changes in piping direction and at concentrated loads. Hangers shall provide for vertical adjustment to maintain pitch required for proper drainage, and for longitudinal travel due to expansion and contraction of piping. Fasten hangers to building structural members wherever practicable.

E. Hangers in direct contact with copper pipe or tubing shall be copper plated.

F. Unless indicated otherwise on drawings or in manufacturer's literature, support horizontal piping as follows:

NOM. TUBING SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1"	3/8"	6 Ft.
1-1/4" to 1-1/2"	3/8"	8 Ft.
2"	3/8"	9 Ft.

G. Provide continuous threaded hanger rods wherever possible. No chain, wire, or perforated straps shall be used. Hanger rods shall be subject to tensile loading only, where lateral or axial pipe movement occurs provide suitable linkage to permit swing. Provide pipe support channels with galvanized finish for concealed locations and painted finish for exposed locations. Submit design for multiple pipe supports indicating pipe sizes, service and support detail to Architect/Engineer for review prior to fabrication.

H. Provide Grinnell Fig. 194, 195, or 199 steel wall brackets for piping suspended or supported from walls. Brackets shall be prime coated carbon steel.

I. Mount hangers for insulated piping on outside of pipe insulation sized to allow for full thickness of pipe insulation. Provide Grinnell Fig. 167 insulation protection shields sized so that line compressive load does not exceed one-third of insulation compressive strength. Shield shall be galvanized steel and support lower 180 degrees of pipe insulation on copper tubing.

J. Structural attachments for pipe hangers shall be as follows:

1. Concrete Structure: Provide Grinnell Fig. No. 285 concrete insert for loads up to 400 lbs. and Grinnell Fig. 281 wedge type concrete insert for loads up to 1200 lbs.
2. Steel Beam Structure: Provide Grinnell Fig. No. 86 malleable iron C-clamp for pipe size 2" and smaller and Grinnell Fig. 229 malleable iron beam clamp for pipe size 2-1/2" and larger.

K. Equivalent hangers and supports by Auto-Grip, Basic Engineer, Elcen, Fee & Mason, Fluorcarbon Company, Unistrut or Super Strut Inc., B-Line.

2.6 CONCRETE INSERTS AND ANCHORS

A. In new construction where attachment points can be predetermined provide Fee & Mason Fig. 9000 continuous concrete insert of Fig. 186 Universal Steel concrete insert.

B. Equivalent by B-Line.

2.7 CLEANOUTS

A. Provide cleanout the full size of soil pipe served up to 4" I.D. Cleanouts for soil lines larger than 4" shall be 4". Provide cleanouts in base of soil pipe stacks, ends of sewer main, at changes in direction of over 45 degrees and in horizontal pipe runs exceeding 100 feet at 50 foot intervals.

B. Install cleanouts so they are accessible by extending them through walls, floors, to outside of building or to above grade as required.

C. Where exterior cleanouts do not occur in sidewalks, paved roadways, etc., provide a concrete pad with top 1-1/2" above finished grade, see detail on drawings.

For Clubhouse / Commons Areas:

1. Floor (Concrete Floor Finish): Zurn #ZN 1405-3 "Supremo Level-Trol Tuf-Top" dura-coated iron cleanout with square, heavy duty, scoriated Zurn nickel bronze with adjustable above to finished floor.
2. Floor (Quarry Tile Floor Finish): Same as concrete floor finish.
3. Floor (Tile Floor Finish): Zurn #ZN-1405.7 "Supremo-Level-Trol-Tuf-Top" dura-coated cast iron cleanout with square heavy duty Zurn nickel bronze top, recessed for tile and adjustable to finished floor.
4. Floor (Carpet Floor Finish): Zurn #ZN-1405.14" "Supremo-Level-Trol-Tuf

Top" dura-coated cast iron cleanout with round, heavy duty Zurn nickel bronze top with carpet retainer and adjustable to finished floor after concrete has set.

5. Wall: Zurn ZN-1440.4 "Supremo" cleanout with dura-coated cast iron ferrule and cadmium plated cast iron counter-sunk plug complete with square smooth Zurn nickel bronze wall access cover and flush over-wall frame.
6. Yard: Zurn Z-1460-15 round dura-coated cast iron cleanout housing with integral seepage pan. Housing shall be complete with secured scoriated cover with lifting device.

For Apartments:

1. Provide adjustable ABS/PVC body unit with nickel bronze cover, Sioux Chief #852 series.

D. Verify floor materials used from Architectural plans and provide proper cleanout tops, where they occur in carpet, quarry tile, vinyl tile or ceramic tile.

E. Equivalent cleanout by Sioux Chief, J.R. Smith, Wade, Ancon or Josam.

2.8 SHOCK ARRESTORS

A. Provide Zurn Z-1700 bellows type water hammer arrestor on all banks shown sized for manufacturer's recommendations.

B. Install with shut-off in accessible location.

C. Equivalent by Josam, Smith, Wade, Amtrol.

2.9 FLOOR DRAINS

A. Unless otherwise noted, provide each drain with deep seal P-trap at the drain.

B. See schedule on drawings.

2.10 WALL HYDRANT

A. Woodford #17 anti-siphon auto draining exposed unit with cast bronze face, key operation, all bronze parts.

B. Equivalent by Wade, Smith, Josam.

2.11 BACKFLOW PREVENTERS

A. Where shown and where required by code, provide Watts 709-S-QT or 909-S-QT device with strainer and ball valve isolators.

B. Equivalent by Febco, ITT, Zurn.

2.12 WATER HEATERS

A. See drawings. Equivalent by Bradford White, American, State, Rheem.

2.13 SUMP PUMP

A. Elevator: Zoeller #152 submersible cast iron pump with Oil Smart System with stainless steel strainer, float control, 1750 rpm sealed motor, permanently lubricated bearings. Unit to have simplex #8112, 8230 tethered float with piggyback cord, adjustable setpoints. Provide 24" Ø by 24" deep sump with split cover. Set cover up off rim ½" with bolts to allow drainage into sump. Pump to provide 50 gpm at 18 ft. head with 1/2 hp 120v motor. Provide with check valve, 2" discharge pipe to exterior.

2.14 DOWNSPOUT NOZZLE

A. Zurn #ZANB-199 nickel bronze body, threaded inlet, decorative wall flange and nozzle.

B. Equivalent by Wade, Josam, Smith, Sioux Chief.

2.15 ROOF DRAINS

A. See drawings.

B. Equivalent drains by J.R. Smith, Zurn, or Josam.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Piping systems materials and installation shall conform to the latest standards and codes. Mechanical contractor shall take full responsibility for the final selection, installation and integrity of the piping support system.

B. Pipe sizes indicated on plans and as specified refer to nominal size in inches for steel pipe, cast iron pipe and copper tubing, unless otherwise indicated. Pipes are sized to nearest 1/2". In no case shall piping smaller than size specified be used.

C. Contractor shall provide and be responsible for proper location of pipe sleeves, hangers, supports, and inserts. Install hangers, supports, inserts, etc., as recommended by manufacturer and as specified and detailed on drawings. Verify construction types and provide proper hangers, inserts and supports for construction used. Install inserts, hangers and supports in accordance with manufacturers load ratings and provide for thermal expansion of piping without exceeding allowable stress on piping or supports.

D. Install piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping system. Secure piping with approved anchors and provide guides where required to insure proper direction of piping expansion. Piping

shall be installed so that allowable stress for piping, valves and fittings used are not exceeded during normal operation or testing of piping system.

E. Install piping so that systems can be completely drained. Provide piping systems with valve drain connections at all low pipe and ahead of all sectionalizing valves whether shown on plans or not.

END OF SECTION 221100

SECTION 230500 - COMMON WORK RESULTS FOR MECHANICAL SYSTEM

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

A. All contract documents including drawings, alternates, addenda, and modifications in addition to this specification are applicable to the MECHANICAL Contractor (M/C) and his Subcontractors, and material suppliers.

B. Engineer, wherever used in the specifications, shall mean Latimer Sommers & Associates, P.A., 3639 S.W. Summerfield Dr., Topeka, KS 66614, 785-233-3232, lsapa@lsapa.com.

C. Contractor, wherever used in these specifications, shall mean the company that enters into contract with the General Contractor or Owner to perform this section of work.

D. When a word such as “proper”, “satisfactory”’ “equivalent”, and “as directed”, is used, it requires Engineer’s review. “Provide” means furnish, install, and commission.

E. Changes or deviations from the contract, including those for additional work, must be submitted in writing for review by the Engineer.

F. If conflicts or ambiguities are present between the drawings and specifications, the contractor shall contact the Engineer for clarification. If no resolution is made by the Engineer via an addendum, the more costly option shall be included in the contract. Contractor shall notify Engineer as soon as possible for a resolution.

G. Do not scale MECHANICAL drawings for dimensions. Accurately lay-out work from dimensions indicated on Architectural drawings unless such is found in error.

H. Items not shown on the drawings or in the specifications, but reasonably inferred from the documents shall be included in the contract.

I. Contractor may be allowed access to the CAD drawings files produced by the Engineer upon written release and payment of charges.

1.2 LOCATIONS AND INTERFERENCES

A. Contractor shall visit site to determine existing site conditions that affect the contracted work.

B. Locations of equipment, piping and other mechanical work are indicated diagrammatically by the drawings. Determine exact locations on site, subject to structural conditions, work of other Contractors, access requirements for installation and maintenance to the approval of the Engineer.

C. Study and become familiar with the contract drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for installation. Cooperate with other contractors and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Engineer. Failure of contractor to coordinate with other trades prior to construction is not cause for additional compensation.

D. Any pipe, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed and if so shown, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, the Subcontractor, or workers shall be restored as specified for new work.

1.3 QUALITY ASSURANCE

A. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions.
2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 100 miles of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Submit names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, critical instrumentation, computer workstation and programming.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
5. Asbestos products or equipment or materials containing asbestos shall not be used.
6. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

B. Warranty

1. Contractor warrants to Owner and Architect the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of mechanical systems by Owner.
2. Contractor warrants to Owner and Architect that on receipt of written notice from either of them within one year warranty period following date of acceptance that defects have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor's expense.
3. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, install equipment or accessories per these instructions including all items needed to fulfill these requirements. Any discrepancy between these instructions, Code, and the contract documents shall be brought to the attention of the Engineer for interpretation. Installation shall meet manufacturer’s recommended clearances. Any conflicts shall be brought to the attention of the Engineer prior to installation.

D. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

1.4 MATERIALS, EQUIPMENT, AND SUBSTITUTIONS

A. The intent of these specifications is to allow competition in bidding on standards of materials and equipment required. Material and equipment installed under this contract shall be first class quality, new, unused and without damage unless shown otherwise on the drawings.

B. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product may be used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.

C. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.

D. Prior to receipt of bids, if contractor wishes to incorporate products other than those named in specifications in his base bid, he shall submit a written request for review of substitutions to Engineer not less than five working days prior to bid time. Engineer may review requests and acceptable items will be listed in an addendum issued to principal bidders.

E. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison. Differences between specified and submitted items shall be listed by the supplier/contractor and included with the submittal.

F. In proposing a substitution prior to or subsequent to receipt of bids, include in such proposal cost of altering other elements of project, including adjustments in mechanical electrical service requirements necessary to accommodate such substitution; whether such affected elements to this contract or under separate contracts.

1.5 SUBMITTALS

A. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Information shall be clearly marked as to individual model to be provided on this project. Do not submit operations manuals, installation guides, wiring diagrams, or other voluminous documents unless requested by Engineer. If the Contractor feels these items are pertinent in the review, prior approval shall be obtained from the Engineer. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been reviewed, no change in brand or make will be permitted unless approved by the Engineer.

B. Engineer may review submittals only as a courtesy to the contractor. Contractor has the obligation to provide items/work in the contract documents or reasonably inferred. The lack of comments, notes, or other indications made by the Engineer on a submittal does not relieve the contractor from providing the necessary items/work. Review by the Engineer does not constitute “approval” of items submitted. Engineer will not check quantities, dimensions, etc. for accuracy or appropriateness.

C. Forward submittals in sufficient time to permit proper consideration by the Engineer. Provide submission to assure adequate lead time for procurement. Delays attributable to untimely and rejected submittals will not serve as a basis for extending contract time for completion. Engineer shall endeavor to review submittals in two weeks.

D. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor and shall contain the list of items, name of project, name of Contractor, supplier and their contact numbers, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, submittals shall be marked to indicate specific items submitted for approval. Submittal shall bear the Contractor’s approval

stamp indicating they have reviewed the submittal for conformance to the contract documents.

E. Where required by these specifications, the drawings, or the Engineer, provide scaled shop drawings of the piping systems and/or equipment to reflect actual routing, location, coordination with other trades and structure, and maintenance accessibility. Review with Engineer scope of the documents prior to submission.

F. Upon request of the Engineer, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.

1.6 OPERATIONS AND MAINTENANCE MANUALS

A. Submit two copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Instructions shall be prepared by equipment manufacturer.

B. Present to Owner, keys and wrenches furnished with equipment under this contract and obtain receipt for same upon completion of project.

C. Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to Architect-Engineer for review before delivery to Owner. Provide brochures bound in three-ring binders with metal hinge. Clearly print project and section covered on label insert of each brochure. Brochures shall contain following:

1. Certified equipment drawings/or catalog data with equipment provided clearly marked.
2. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
3. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of mechanical system.
4. A complete set of as-built drawings to scale showing all mechanical systems as installed.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage. This shall include any existing, relocated or owner-furnished equipment/systems.
2. Place damaged equipment in first class, new operating condition; or replace same as determined and directed by the Engineer. Such repair or replacement shall be at no additional cost to the Owner.

3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before installing or placing equipment in operation.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or cleaned as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.8 SAFETY AND SECURITY

A. Visits to the site shall be pre-arranged through the Owner's representative.

B. Contractor shall follow OSHA safety regulations while on site and have an OSHA-trained individual on site at all times.

C. Contractor shall follow Owner's safety and security regulations with regards to identification, keys and access, document control, motor vehicles, firearms, illegal substances, smoking, etc as per the Owner's request.

D. Contractor shall follow fire safety rules per OSHA and NFPA standards regarding temporary facilities, maintaining fire exiting, fire suppression and alarm systems, hot work, storage, utilities, etc.

1.9 DISPOSAL AND RETENTION

A. Waste materials, including those considered hazardous, accrued from the construction process shall be removed promptly from the project site in a manner approved by the authorities having jurisdiction.

B. Verify with the owner any items that may be retained by the owner for future use or salvage prior to removal.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.

2. Constituent parts that are alike shall be products of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.
4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

B. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

C. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.3 LIFTING ATTACHMENTS

A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.4 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING

A. All material and equipment furnished and installation methods shall conform to the requirements of other sections of this specification. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient motors as scheduled. Unless otherwise specified for a particular application use electric motors with the following requirements.

B. Special Requirements:

1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the owner.
2. Assemblies of motors, starters, controls, and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:

a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers or heaters.
b. Other wiring at boilers or heaters and to control panels shall be NFPA 70 designation THWN.
c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.

4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
5. Motors utilized with variable frequency drives shall be rated “inverter-ready” per NEMA Standard, MG1, Part 31.4.4.2.

C. Motor Efficiency and Power Factor: All motors, when specified as “high efficiency” by the project specifications on driven equipment, shall conform to efficiency and power factor requirements generally defined by motor manufacturers as “NEMA premium efficient” and the requirements generally exceed those of the Energy Policy Act of 1992 (EPACT). Motors not specified as “high efficiency” shall comply with EPACT.

D. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC).

E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

F. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees centigrade (104 degrees F); minimum horsepower as shown on drawings; maximum horsepower in normal operation not to exceed nameplate rating without service factor.

G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

2.5 ELECTRICAL REQUIREMENTS

A. Electrical work required to install and control MECHANICAL equipment which is not shown on plans or specified under sections in series 26000 shall be included in M/C's base bid proposal.

B. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which was not used for basis of design shall be paid for by M/C at no cost to Owner or A/E.

C. M/C shall be responsible for providing supervision to E/C to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.

D. M/C shall be responsible for providing supervision to E/C to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.

E. Furnish complete sets of electrical wiring diagrams to A/E and to E/C. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by E/C shall be clearly indicated by notation and drawing symbols on wiring diagrams.

F. Safety disconnect switches and manual and magnetic motor starters shall be provided by the M/C where not provided by the E/C per the drawings.

2.6 FIRESTOPPING

A. Provide an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping with a U.L. listed firestop material and in a U.L. listed assembly configuration. Submit material and assembly detail for review.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Coordinate location of piping, sleeves, inserts, hangers, and equipment, access provisions, and work of all trades. Locate piping, sleeves, inserts, hangers, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.

C. Cutting Holes:

1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed.
2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by A/E.
3. Do not penetrate membrane waterproofing.

D. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

E. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Resident Engineer. Damaged or defective items in the opinion of the Resident Engineer, shall be replaced.
2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water, chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

F. Concrete and Grout: Use concrete and shrink compensating grout 3000 psi minimum.

G. Inaccessible Equipment:

1. Where the A/E determines that the M/C has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

A. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities.

B. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

C. All temporary shut-downs of service shall be coordinated with the owner and other trades as needed to maintain operating service in the facility. Off-hours work is normally needed to accomplish these and shall be included in the contract.

3.3 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the facility for beneficial use by the Owner, equipment and systems shall be thoroughly cleaned and touch-up painted if damaged.

B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
2. Material And Equipment Not To Be Painted Includes:
   a. Motors, controllers, control switches, and safety switches.
   b. Control and interlock devices.
   c. Regulators.
   d. Pressure reducing valves.
   e. Control valves and thermostatic elements.
   f. Lubrication devices and grease fittings.
   g. Copper, brass, aluminum, stainless steel and bronze surfaces.
   h. Valve stems and rotating shafts.
   i. Pressure gauges and thermometers.
   j. Glass.
   k. Name plates.
3. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

3.4 STARTUP AND TEMPORARY OPERATION

A. Start up equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

END OF SECTION 230500

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SECTION 230593 - TESTING & BALANCING

PART 1 – GENERAL

1.1 TESTING AND BALANCING

A. Testing and balancing of the building air and water systems will be to be completed near the end of construction. The Mechanical Contractor has responsibility to cooperate with, make adjustments for, and provide any equipment necessary for the TAB agency to complete the job.

1.2 ACCEPTABLE TESTING AND BALANCING FIRMS:

A. Firm shall be third party, NEBB or AABC certified. Submit qualifications, references and a project list of similar size and scope to Engineer for approval.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 SYSTEM PREPARATION FOR TESTING AND BALANCING

A. Prior to requesting testing and balancing agency to perform their work the installing contractor shall make all necessary inspections and adjustments to ensure that systems are completely installed and operating in accordance with the manufacturer's recommendations and the contract documents.

B. The following checks shall be performed on each system installed under this contract. A report sheet shall be prepared for each system indicating checks made, corrective action taken where required, date, and name of person making inspection. Submit one copy to testing and balancing agency and two to A/E. Testing and balancing agency will not begin until checklist has been received and reviewed.

1. Air Handling Systems:

    a. Clear system of all foreign objects and clean system.
    b. Verify fan rotation.
    c. Check bearing condition and lubrication.
    d. Check fan wheel clearances and fan alignment.
    e. Check motor security to mounting base.
    f. Check alignment of drive.
    g. Check vibration isolator adjustment.
    h. Verify that proper filter media is installed.
    i. Verify that all control dampers are installed and operable without binding or sticking.
    j. Confirm that all fire, smoke and volume dampers are installed and in full open position.

k. Verify that all air terminal units are installed.
l. Confirm that all air openings in walls above ceilings have been provided.
m. Check for and repair all excessive air leaks in duct systems, at equipment connections and at coils.
n. Air leaks shall not exceed SMACNA parameters for system pressure.
o. Verify that ductwork is constructed and installed in accordance with contract drawings and/or approved ductwork shop drawings.

3.2 AIR BALANCE

A. The Subcontractor shall procure the services of the independent air balance and testing agency, approved by the Engineer, which specializes in the balancing and testing of heating, ventilating and air conditioning systems, to balance, adjust, and test air moving equipment and air distribution and exhaust systems. All work by this agency shall be done under direct supervision of a qualified heating and ventilating engineer employed by them. All instruments used by this agency shall be accurately calibrated within six months of performing work and maintained in good working order. If requested the tests shall be conducted in the presence of the Engineer responsible for the project and/or its representative. The testing and balancing firm shall be certified by NEBB or AABC and all work shall be performed in accordance with these organizations' published procedure manuals.

B. Air balance and testing shall not begin until systems have been completed and are in full working order. All heating, ventilation, and air conditioning systems and equipment shall be in full operation during each working day of testing and balancing.

C. The Subcontractor shall make changes in pulleys, belts, dampers, etc., as required by the test and balance agency, at no additional cost to the Owner.

D. The Subcontractor shall install new filters in the air handlers and clean all strainers in the water system just prior to the beginning of the testing and balancing.

E. The control manufacturer or its representative shall assist the test and balance agency in setting automatic dampers, valves, etc., as required.

F. The balancing agency shall prepare a certified report of all tests performed. The report shall be written on standard forms prepared by NEBB or AABC or facsimiles thereof. The balancing agency shall submit 3 copies of this report to the Subcontractor who shall submit them to the A/E for review and distribution.

G. The air shall be balanced to within + 10% of design requirements. Two apartments of each type shall have total air flow checked and adjusted (not individual outlets). The remainder of the units shall be set to the same fan speed as is adjusted in the sample units. Common area systems shall receive total balancing.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 DUCTWORK INSULATION

A. Provide necessary materials and accessories for installation of interior and exterior ductwork insulation as specified and/or detailed on drawings. Insulation type and thickness for specific ductwork systems shall be as listed in insulation schedule in this section of specification.

B. Provide insulation materials manufactured by Armstrong, Certain-Teed/Saint Gobain, Johns-Manville or Owens-Corning.

C. Insulation and application adhesives, except where specified otherwise, shall have fire and smoke hazard rating as tested by ASTM E-84 procedure not exceeding:

FLAME SPREAD	25
FUEL CONTRIBUTED	50

Insulation shall meet ASTM C411 performance test and shall be installed in conformance with NFPA Standard 90A.

D. Abbreviations for manufacturers of adhesives, insulating cements and coatings specified shall be C.M. for Chicago Mastic Company, B.F. for Benjamin Foster Company and 3M for 3M Company. Average thermal conductivity is expressed in BTU/Hr/Sq.Ft./ degrees F/In.

E. Install interior duct liner insulation cut to insure tight fitting corner, and longitudinal joints. Apply liner to sheet metal with 100% coverage of C.M. No. 176-477, B.F. No. 81-19 or 3M No. 36 adhesive applied in accordance with manufacturers recommended applications rate. Coat all edges of liner with adhesive. Provide mechanical fasteners on surfaces 18" or wider in addition to liner adhesive with fastener clips set flush with duct liner surface. Provide fasteners as follows:

1. Low Velocity Ductwork (Velocities less than 2000 FPM): Provide fasteners within 3" of leading edge of each section 12" O.C. around joint perimeter and 3" from longitudinal joints 12" O.C. Elsewhere space fasteners 18" O.C. except not more than 6" from longitudinal joints9 not 12" from corner break.

F. Provide round sheet metal ductwork with exterior thermal insulation of type and thickness listed in insulation schedule. Apply insulation with joints tightly butted together with longitudinal and end joint strips sealed with vapor barrier adhesive. Insulate fittings with insulation thickness equal to adjoining insulation with cover overlapping 2" onto adjacent covering.

G. Duct insulation materials by type shall be as follows:

1. Type 1-DIL: Internal acoustical and thermal duct insulation for low and high velocity ductwork shall be CertainTeed Ultralite 300 3 lb. density duct lines with .24 K factor at 75 degrees F mean temperature.
2. Type 2-DEW: External thermal insulation for low, medium and high pressure round duct shall be Shuller Microlite Type 75 standard duct insulation type IV with foil-scrim-kraft facing and .27 BTUH thermal conductivity at 75 degrees mean temperature.

2.2 HVAC DUCT PIPING SCHEDULE

DUCTWORK SYSTEM	TYPE	DUCT LINING THICKNESS
Common Areas, Attics or Unconditioned Area:		
Rectangular Supply	2-DEW	1-1/2"
Rectangular Return	1-DIL	1"
Round Supply	2-DEW	1-1/2"
Exhaust	NONE	

Ducts located in unconditioned areas shall be insulated to R-8 minimum.

2.3 PIPING INSULATION

A. General Requirements

1. Provide necessary materials and accessories for installation of insulation for plumbing and mechanical systems as specified and/or detailed on drawings insulation type, jacket, and thickness for specific piping systems or equipment shall be as listed in insulation schedule.
2. Provide insulation materials manufactured by Armstrong Cork Co. Certain/Teed Saint Gobain, Dow Chemical, Johns-Manville or Owen-Corning Fiberglass.
3. Insulation, except where specified otherwise, shall have composite fire and smoke hazard ratings as rested by ASTM E-84, NFPA 255, and UL 723 procedures not exceeding:

FLAME SPREAD	25
SMOKE DEVELOPED	50
FUEL CONTRIBUTED	50

4. Provide insulation accessories such as adhesives, mastics, cements, tape and glass fabric with same component ratings as listed above. Products or their shipping cartons shall bear label indicating their flame and smoke safety shall be permanent.
5. Install insulation over clean dry surfaces with joints firmly butted together. Insulation at equipment, flanges, fittings, etc. shall have straight edges with box type joints with corner beads as required. Where plumbing and heating insulation terminates at equipment or unions, taper insulation at 30 degree angle to pipe with one coat finishing cement and finish same as fittings. Total insulation system shall have neat smooth appearance with no wrinkles, or folds in jackets, joint strips or fitting covers.
6. Undamaged insulation systems on cold surface piping and equipment shall perform

their intended functions as vapor barriers and thermal insulation without premature deterioration of insulation or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.

7. Insulation of removable heads, manholes access covers, etc., shall be fabricated to allow removal without damage to insulation. Provide removable units with vapor-proof cover fabricated to be sealed to equipment vapor barrier.
8. Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at Mechanical Contractors expense at no cost to owner.

B. Insulation Materials and Application Methods (Piping)

1. TYPE 1-PHC: Insulation for hot and cold surface piping systems with +40 degrees F to +450 degrees F operating range shall be Owens-Corning Fiberglass 25, 4.0 lb. density pipe insulation with white fire retardant ASJ jacket. Average thermal conductivity shall not exceed .26 BTU/Hr. at 75 degrees F mean temperature. Seal longitudinal jacket laps and butt strips with C.M. No. 17-465 or B.F. No. 85-75 vapor barrier adhesive. Insulate valves and fittings as follows:
   a. Insulate exposed and concealed valves and fittings with 2" thick glass fiberglass inserts or blankets. Cover fittings with Zeston Products PVC fitting covers or approved equal. PVC fitting covers shall be secured with mechanical fasteners such as tacks or staples for temperatures above 75 degrees F. For cold service all joints shall be sealed with vapor barrier adhesive or by pressure sensitive vapor barrier vinyl tape.

C. Insulation materials and application methods (Equipment)

1. Type 1-PC: Insulation for cold surface equipment insulation for external surfaces with +40 degrees F to +220 degrees F operating temperature range shall be Armstrong FR/Armaflex pipe or sheet insulation as required with 5.5" or 6.0 lb. density. Average thermal conductivity shall not exceed .27 BTU/HR at 75 F mean temperature. Apply insulation directly to metal surfaces and seal insulation joints with Armstrong No. 520. Insulation shall be mitered, beveled and built-up as required to provide a smooth and neat exterior surface. On large pumps and equipment provide joints in insulation at points where equipment casing must be disassembled for maintenance and repair. Insulate these joint areas so that insulation can be easily removed from casing joints without removing or damaging adjacent insulation. Finish insulation with two coats of Armstrong Armaflex vinyl-lacquer finish.

D. Insulation Materials and application methods (hangers, supports, anchors, guides, expansion joints, etc.)

1. Insulation materials and application methods for piping hangers supports, anchors,

guides expansion joints, etc., shall be as follows:

Insulate hangers and supports from direct contact with 3" and above piping with Styrofoam HD-300 plastic foam inserts of half or full sections. Provide inserts with vapor barrier jacket for lapping 2" over adjoining insulation. Insert jacket shall be equal in performance and appearance to adjacent pipe insulation jacket. On 1-1/4" to 2-1/2" piping, protect insulation with properly sized wood dowels cut within insulation. 1" pipe and below needs no inserts. Seal joints with vapor barrier sealer specified for insulation type used.

2. Where piping hanger cannot be isolated from cold pipe surfaces insulate piping at hanger locations with extra thickness of pipe insulation. Insulate hanger rod to point 12" above pipe with minimum insulation thickness equal to one-half thickness of pipe insulation. Seal and finish joints with vapor barrier sealer for insulation type used.
3. Pipe and Valve Insulation Schedule

SYSTEM	SIZE	TYPE	THICKNESS
Refrigerant Suction	Below 7/8”	1-PC	5/8”
Refrigerant Suction	Above 7/8”	1-PC	1”

PART 3 - EXECUTION

END OF SECTION 230700

SECTION 233100 - DUCTWORK

PART 1 - GENERAL

1.1 GENERAL

A. Construct ductwork as detailed on drawings and as detailed in the latest edition of the Sheet Metal and Air Conditioning Contractor's Association (SMACNA) Duct Manual. Details shown on project plans shall indicate specific construction methods to be used on this project, and shall be used in lieu of any alternate methods shown in SMACNA Duct Manual.

B. Provide two copies of 1/4" - 1'-0" scale fabrication drawings of proposed ductwork and equipment layout to Engineer for approval prior to fabrication. Drawings shall establish that ductwork and equipment will fit allotted spaces with necessary clearance for installation and maintenance. Indicate on drawings proposed details for attaching, anchoring and hanging ductwork and equipment from structural framing of building. Where departures from project plans are deemed necessary by Contractor, details and changes shall be clearly shown on fabrication drawings and reasons for proposed changes noted.

C. Construct and install ductwork to be completely free from vibration under all conditions of operation. Support and securely anchor ductwork and equipment from structural framing of building. Provide suitable intermediate metal framing where required between building structural framing.

D. Construct ductwork in accordance with operating static pressure range. Ductwork pressure classifications shall be as follows:

1. Systems operating static pressure 1/2" positive or negative of W.G. - Returns, all exhaust and relief ducts and supply ducts for fan coil units.

E. All metal ductwork scheduled for interior thermal and acoustical liner is not sized on plans to include the proper thickness of insulation. Add 1" or 2" in height and width of ductwork as required to accommodate insulation thickness. Mount specialties such as turning vanes, campers, etc., to ductwork with that section insulated "Build Outs" to maintain continuity of thermal barrier.

F. Construct low pressure system ductwork to conform to latest edition of low pressure duct construction standards of SMACNA Duct Manual.

PART 2 - PRODUCTS

2.1 DUCTWORK

A. Provide snap-lock duct on all round ductwork 12" and under. Any exposed ductwork shall be spiral wound type without sealant.

B. Sealing of low and high pressure ductwork shall be Class “C” caulked or gasket type joining system such as Ductmate. (Clubhouse / Common Areas)
C. Flexible ductwork shall be poly inner membrane with integral spiral wire. Provide 1” fiberglass insulation and outer vapor barrier membrane.

2.2 SHEET METAL SPECIALTIES

A. Specialties shall be factory fabricated items designed for low, medium or high velocity systems as required. Submit shop drawings on all specialties required with shop drawings of ductwork layout. Equivalents on prior approval. Specialties shall be as follows:

1. Turning Vanes: Single blade vanes mounted 2-1/8" on center on 24 gauge runners. Air turns by Barber- Coleman will be acceptable on low pressure only. Note: Turning vanes to be provided on all supply, return and exhaust ducts.
2. Extractors (Low Velocity): Carnes #1250 all aluminum air volume extractor. Unit shall be adjustable from full open to full closed position.
3. Dampers: Provide 24 gauge minimum galvanized metal blades supported on duct with metal supports and locked in position with locking type damper arm.
4. Fire Damper (Round): Prefco type CR frame 100% free area folding blade type with UL approved 165 degree fusible link. Fire Damper (Rectangular): Prefco model 5500 1-1/2 or 3 hr. as shown on plans or equal type BC frame, 100% free area, folding blade type with UL approved 165 degree fusible link. (Fire Damper Rectangular-Low Velocity). Prefco LPB frame with 165 degree fusible link. Provide radiation dampers where penetrating membrane only of fire rated barriers at all ceilings. Prefco 5680 at ceiling diffusers and at AHU’s for ceiling radiatin damper applications. Through penetrations shall be Prefco 5500 E6 LPB fire damper. Install fire dampers in accordance with NFPA-90A and UL Standards 555. Equivalent dampers by Ruskin.
5. Backdraft Dampers: Unless backdraft dampers are specified with a particular piece of equipment. Provide Cesco #BDA or equal with 16 gauge aluminum blade with oiled bearings mounted in steel frame. Blades shall be balanced and connected with tie bar. Provide end seals and blade seals. Equivalent by Ruskin.
6. Flexible Connections: Metaledge Ventglas prefabricated flexible connection of 3-1/4" wide heat and fire resistant neoprene coated glass fabric with two 3" wide 24 gauge metal strips attached to each edge. Vent Fabrics, Inc., Duro-dyne Corp. or equal.
7. Access Doors: Provide access doors in ductwork ceiling, walls, or floors for access to ductwork valves, controls, piping etc., installed under this contract. Doors and frame shall be formed of not lighter than USS #14 gauge and #16 gauge steel, respectively. Hinges shall be concealed loose pin spring type. Locks shall be flush, screwdriver, cam action type. Doors and frames shall be furnished in prime coat of Higgins, Milcor, Donley or equal.
8. Round take-off fittings from supply diffusers or registers to low pressure

supply ductwork shall be Flexmaster #FLDE complete with locking damper and air scoop. Equivalent by Atco, Air Control Products.

9. Low Pressure Flexible Duct: Thermaflex G-KM rated for 2" W.G. maximum positive and 2" W.G. maximum negative pressure and 2500 FPM maximum velocity. UL listed "UL-181 Standards Class I Duct Material" complying with NFPA Standards 90A and 90B. Duct shall be composed of inner polymeric liner duct bonded to coated steel wire helix. Equivalent by Wiremold, Cleavaflex, Flexmaster with fiberglass insulation and vinyl cover. Limit length to 6 ft.
10. Louvers: Provide Greenheck ESJ-202 extruded aluminum stationary blade louver with extended sill, birdscreen, mill finish. Equivalent by Ruskin, Nailor, Cesco, Louvers and Dampers, Carnes.
11. Fire/Smoke damper: Fire/Smoke Dampers: Prefco 5020 Combination damper with 165□ fusible link and 5800 MBZX power open spring closed unit, electric actuator. Equal to Ruskin, Cesco, Louvers and Dampers.

PART 3 - EXECUTION

3.1 Provide shoe type branch take-offs for rectangular duct and splitter dampers where teeing for Clubhouse and common areas.

3.2 Review Architectural Code plans to ascertain fire rated walls, floors, ceilings and membranes. Protect all mechanical penetrations appropriately and according to a U.L. detail.

END OF SECTION 233100

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SECTION 233400 - FANS

PART 1 - GENERAL (Reference Section 230500)

1.1 GENERAL REQUIREMENTS

A. Provide where shown on plans fans as hereinafter specified. Equivalent by Carnes, Cook, Penn, Greenheck, Acme, or Jenn-Air.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL POWER ROOF/WALL VENTILATOR

A. Ventilator covers shall be aluminum specifically designed to withstand high wind loads. Wheels 12" in diameter and larger shall have airfoil or medium foil blades. The motor and drive compartment shall be positively externally ventilated. Drive components shall be isolated from the structure. Bearings shall be designed for 200,000 hours operation.

B. Provide insulated roof curbs sloped where over ¼” per foot incline.

C. Provide disconnect switch.

2.2 CENTRIFUGAL POWER IN-LINE EXHAUST FAN

A. Fans shall be constructed of heavy gauge steel with electro-coated acrylic enamel finish over iron phosphate primer. Bearings shall be pre-lubricated and sealed for minimum maintenance and design for 200,000 hours operation.

B. Internal parts, wheel, shaft, bearings, motor and drive shall be accessible for inspection, repair or replacement without disturbing inlet or outlet ductwork.

C. Fans shall be furnished with a mounted safety disconnect. Single phase motors shall have integral overload protection. Provide backdraft dampers, rubber in shear isolators and rods as required to support fans from structure. Performance ratings shall be certified air and sound.

2.3 CEILING FANS

A. Ceiling mounted exhaust fans shall be of the centrifugal direct drive type. Housings shall be steel with duct collar and backdraft damper. Grilles shall be high-impact, non-yellowing polystyrene.

B. Access for wiring shall be internal with plug-in type disconnect.

C. Motor shall be on vibration isolators. Fan wheel shall be forward curved centrifugal type, dynamically balanced and bear the AMCA seal and U.L. label.

2.4 SIDEWALL MOUNTED PROPELLER FANS

A. General Description:
   1. Fan arrangement shall be exhaust sidewall mounted application, see Fan Schedule.
   2. Maximum continuous operating temperature 130 Fahrenheit (54.4 Celsius)
   3. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number

B. Wheel
   1. Propeller shall be aluminum blade riveted to steel hub
   2. A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft
   3. Statically and dynamically balanced in accordance with AMCA Standard 204-05
   4. The propeller and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency

C. Motors:
   1. Motor enclosures: Totally enclosed fan cooled.
   2. Motors are permanently lubricated, sleeve bearing type on sizes 8-12 and ball bearing type on sizes 14-24 to match with the fan load and furnished at the specific voltage and phase.
   3. Accessible for maintenance.

D. Drive Frame:
   1. Drive frame assemblies and fan panels shall be galvanized steel.
   2. Drive frame shall have welded wire or formed channels and fan panels shall have pre-punched mounting holes, formed flanges and a deep formed one piece inlet venture

E. Disconnect Switches:
   1. NEMA rated: 1
   2. Positive electrical shut-off
   3. Wired from fan motor to junction box

F. Accessories:
   1. Dampers:
      a. Type: Motorized.
      b. Prevents outside air from entering back into the building when fan is off
      c. Balanced for minimal resistance to flow
      d. Galvanized frames with pre-punched mounting holes
   2. Dampers Guards:
      a. Guard material: Aluminum.
      b. Shall completely enclose the damper or wall opening on the discharge side of the fan
   3. Finishes: Types: Permatector.
   4. Wall Housing:
      a. Mounting arrangement: Flush Exterior.

b. Constructed of galvanized steel with heavy gauge mounting flanges and pre-punched mounting holes
c. Housing shall include OSHA approved motor guard

5. Wall Collar:
   a. Constructed of galvanized steel with heavy gauge mounting flanges and pre-punched mounting holes

6. Motor Side Guard:
   a. Guard type: Standard Guard.
   b. Protective guard completely enclose the motor and drive side of the fan
   c. Coated with Permatector, a thermal setting polyester urethane

PART 3 - EXECUTION

3.1 Suspend fans in-line on rubber-in-shear isolators and connect ducts with flex duct.

3.2 Provide 14” high insulated roof curb and connect ducts with flex duct for roof fans. Route conduits through curb in lieu of roof membrane.

END OF SECTION 233400

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SECTION 233700 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Provide where shown on plans grilles, registers and diffusers. Refer to schedule at the end of this section.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS AND DIFFUSERS

A. Provide grilles, registers and diffusers as shown on the drawings and hereinafter specified. Set all units with rubber gaskets for air tight connection with mounting surface, see drawings for types, sizes, air flow and quantity.

B. Install all registers with curve of louver away from line of sight. Unless noted otherwise, provide duct mounted diffusers and registers with standard margins. Finish shall match room finish.

C. Provide proper mounting supplies and arrangements for areas shown. Check Architectural drawings for ceiling and all construction. Provide ceiling radiation dampers where in fire-rated ceiling.

D. Equivalent grilles, registers and diffusers by J&J, Price, Titus, Barber-Coleman.

E. Schedule – see drawings.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 233700

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SECTION 237000 - SPLIT SYSTEMS

PART 1 - GENERAL (N/A)

PART 2 - PRODUCTS

2.1 AIR HANDLERS

A. Air handling units shall be completely factory assembled including coil, condensate drain pan, fan motor(s), filters and controls in an insulated casing that can be applied in either vertical or horizontal configuration. Units shall be rated and tested in accordance with ARI standard 210/240, 340/360. Units shall be UL listed and labeled in accordance with UL 465/1995 for indoor blower coil units.

B. Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Casing shall be completely insulated with cleanable, foil-faced, fire-retardant, permanent, odorless glass fiber material. All insulation edges shall be either captured or sealed. Knockouts shall be provided for unit electrical power and refrigerant piping connections. Captive screws shall be standard on all access panels.

C. Evaporator coil to have configured aluminum fin surface, mechanically bonded to 3/8” internally enhanced copper tubing and factory pressure and leak tested at 365 psig. Coil is arranged for draw-through airflow and shall provide a double sloped condensate drain pan constructed of PVC plastic.

D. Evaporator fan shall be double inlet, double width, forward curved, direct drive centrifugal-type fan(s). Thermal overload protection shall be standard on motor. Fan and motor bearings shall be permanently lubricated. All indoor fan motors meet the U.S. Energy Policy Act of 1992 (EPACT).

E. Magnetic evaporator fan contactor, low voltage terminal strip, check valve(s), and single point power entry and disconnect shall be included. All controls shall be factory-installed and wired. Evaporator defrost control shall be included to prevent compressor slugging by temporarily interrupting compressor operation when low evaporator coil temperatures are encountered.

F. Filters shall be one inch throwaway. Filters shall be accessible from the front of the unit.

G. Provide manual changeover 7-day (not 5/2) programmable heating/cooling thermostat.

2.2 CONDENSING UNIT/HEAT PUMP

A. Casing shall be galvanized steel with weather resistant powder paint.

B. Refrigerant controls to include condenser fan and compressor contactor and control system. Compressor overload protection, and service valves are to be provided.

C. Hermetic compressor to have over temperature/pressure protection, epoxy-dipped windings. A 5 year limited compressor warranty to be included.

D. Condenser coil to be copper tubes, aluminum fins with brazed joints protected by louvered panels.

E. Provide all accessories for proper system operation taking into consideration refrigerant pipe length, exposure and position from AHU to account for each specific unit installation. Review drawings with supplier.

PART 3 – EXECUTION

3.1 Air handlers to be mounted on wall bracket with resilient neoprene pads, piped to appropriate drain, mounted with access for service, with flexible duct connections.

3.2 Outdoor units shall be mounted per detail on the drawings for roof-mounted units on synthetic pads. Ground mounted units shall be mounted on monolithic concrete pads that extend to building. Strap down conduits and secure DX piping to wall or slab where over 3 feet in length.

3.3 Install with clearances per manufacturer's recommendations.

END OF SECTION 237000

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

A. All contract documents including drawings, alternates, addenda, and modifications in addition to this specification are applicable to the Electrical Contractor (E/C) and his Subcontractors, and material suppliers.

B. Engineer, wherever used in the specifications, shall mean Latimer Sommers & Associates, P.A., 3639 S.W. Summerfield Dr., Topeka, KS 66614, 785-233-3232, lsapa@lsapa.com.

C. Contractor, wherever used in these specifications, shall mean the company that enters into contract with the General Contractor or Owner to perform this section of work.

D. When a word such as “proper”, “satisfactory”’ “equivalent”, and “as directed”, is used, it requires Engineer’s review. “Provide” means furnish, install, and commission.

E. Changes or deviations from the contract, including those for additional work, must be submitted in writing for review by the Engineer.

F. If conflicts or ambiguities are present between the drawings and specifications, the contractor shall contact the Engineer for clarification. If no resolution is made by the Engineer via an addendum, the more costly option shall be included in the contract. Contractor shall notify Engineer as soon as possible for a resolution.

G. Do not scale electrical drawings for dimensions. Accurately lay-out work from dimensions indicated on Architectural drawings unless such is found in error.

H. Items not shown on the drawings or in the specifications, but reasonably inferred from the documents shall be included in the contract.

I. Contractor may be allowed access to the CAD drawings files produced by the Engineer upon written release and payment of charges.

1.2 LOCATIONS AND INTERFERENCES

A. Contractor shall visit site to determine existing site conditions that affect the contracted work.

B. Locations of equipment, piping and other mechanical work are indicated diagrammatically by the drawings. Determine exact locations on site, subject to structural conditions, work of other Contractors, access requirements for installation and maintenance to the approval of the Engineer.

C. Study and become familiar with the contract drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for installation. Cooperate with other contractors and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Engineer. Failure of contractor to coordinate with other trades prior to construction is not cause for additional compensation.

D. Any pipe, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed and if so shown, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, the Subcontractor, or workers shall be restored as specified for new work.

1.3 QUALITY ASSURANCE

A. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions.
2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 100 miles of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Submit names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, critical instrumentation, computer workstation and programming.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
5. Asbestos products or equipment or materials containing asbestos shall not be used.
6. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

B. Warranty

1. Contractor warrants to Owner and Architect the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of mechanical systems by Owner.
2. Contractor warrants to Owner and Architect that on receipt of written notice from either of them within one year warranty period following date of acceptance that defects have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor's expense.
3. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, install equipment or accessories per these instructions including all items needed to fulfill these requirements. Any discrepancy between these instructions, Code, and the contract documents shall be brought to the attention of the Engineer for interpretation. Installation shall meet manufacturer’s recommended clearances. Any conflicts shall be brought to the attention of the Engineer prior to installation.

D. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

1.4 MATERIALS, EQUIPMENT, AND SUBSTITUTIONS

A. The intent of these specifications is to allow competition in bidding on standards of materials and equipment required.

B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage unless shown otherwise on the drawings.

C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product may be used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.

D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.

E. Prior to receipt of bids, if contractor wishes to incorporate products other than those named in specifications in his base bid, he shall submit a written request for review of substitutions to Engineer not less than five working days prior to bid time. Engineer may

review requests and acceptable items will be listed in an addendum issued to principal bidders.

F. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison. Differences between specified and submitted items shall be listed by the supplier/contractor and included with the submittal.

G. In proposing a substitution prior to or subsequent to receipt of bids, include in such proposal cost of altering other elements of project, including adjustments in mechanical electrical service requirements necessary to accommodate such substitution; whether such affected elements to this contract or under separate contracts.

1.5 SUBMITTALS

A. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Information shall be clearly marked as to individual model to be provided on this project. Do not submit operations manuals, installation guides, wiring diagrams, or other voluminous documents unless requested by Engineer. If the Contractor feels these items are pertinent in the review, prior approval shall be obtained from the Engineer. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been reviewed, no change in brand or make will be permitted unless approved by the Engineer. If electronic submittals are used during the project, two hard copies with the appropriate approval seals shall be sent to the Engineer for his use and review.

B. Engineer may review submittals only as a courtesy to the contractor. Contractor has the obligation to provide items/work in the contract documents or reasonably inferred. The lack of comments, notes, or other indications made by the Engineer on a submittal does not relieve the contractor from providing the necessary items/work. Review by the Engineer does not constitute “approval” of items submitted. Engineer will not check quantities, dimensions, etc. for accuracy or appropriateness.

C. Forward submittals in sufficient time to permit proper consideration by the Engineer. Provide submission to assure adequate lead time for procurement. Delays attributable to untimely and rejected submittals will not serve as a basis for extending contract time for completion. Engineer shall endeavor to review submittals in two weeks.

D. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor and shall contain the list of items, name of project, name of Contractor, supplier and their contact numbers, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of

location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, submittals shall be marked to indicate specific items submitted for approval. Submittal shall bear the Contractor's approval stamp indicating they have reviewed the submittal for conformance to the contract documents.

E. Where required by these specifications, the drawings, or the Engineer, provide scaled shop drawings of the piping systems and/or equipment to reflect actual routing, location, coordination with other trades and structure, and maintenance accessibility. Review with Engineer scope of the documents prior to submission.

F. Upon request of the Engineer, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.

1.6 OPERATIONS AND MAINTENANCE MANUALS

A. Submit two copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Instructions shall be prepared by equipment manufacturer.

B. Present to Owner, keys and wrenches furnished with equipment under this contract and obtain receipt for same upon completion of project.

C. Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to Architect-Engineer for review before delivery to Owner. Provide brochures bound in three-ring binders with metal hinge. Clearly print project and section covered on label insert of each brochure. Brochures shall contain following:

1. Certified equipment drawings/or catalog data with equipment provided clearly marked.
2. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
3. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of mechanical system.
4. A complete set of as-built drawings to scale showing all electrical systems as installed.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for

the protection of such equipment and material against any damage. This shall include any existing, relocated or owner-furnished equipment/systems.

2. Place damaged equipment in first class, new operating condition; or replace same as determined and directed by the Engineer. Such repair or replacement shall be at no additional cost to the Owner.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before installing or placing equipment in operation.
4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or cleaned as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.8 SAFETY AND SECURITY

A. Visits to the site shall be pre-arranged through the Owner’s representative.

B. Contractor shall follow OSHA safety regulations while on site and have an OSHA-trained individual on site at all times.

C. Contractor shall follow Owner’s safety and security regulations with regards to identification, keys and access, document control, motor vehicles, firearms, illegal substances, smoking, etc as per the Owner’s request.

D. Contractor shall follow fire safety rules per OSHA and NFPA standards regarding temporary facilities, maintaining fire exiting, fire suppression and alarm systems, hot work, storage, utilities, etc.

1.9 DISPOSAL AND RETENTION

A. Waste materials, including those considered hazardous, accrued from the construction process shall be removed promptly from the project site in a manner approved by the authorities having jurisdiction.

B. Verify with the owner any items that may be retained by the owner for future use or salvage prior to removal.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be products of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.
4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

B. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

C. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.3 LIFTING ATTACHMENTS

A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.4 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING

A. All material and equipment furnished and installation methods shall conform to the requirements of other sections of this specification. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient motors as scheduled. Unless otherwise specified for a particular application use electric motors with the following requirements.

B. Special Requirements:

1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the owner.
2. Assemblies of motors, starters, controls, and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
   a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers or heaters.
   b. Other wiring at boilers or heaters and to control panels shall be NFPA 70 designation THWN.
   c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.
4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
5. Motors utilized with variable frequency drives shall be rated “inverter-ready” per NEMA Standard, MG1, Part 31.4.4.2.

C. Motor Efficiency and Power Factor: All motors, when specified as “high efficiency” by the project specifications on driven equipment, shall conform to efficiency and power factor requirements generally defined by motor manufacturers as “NEMA premium efficient” and the requirements generally exceed those of the Energy Policy Act of 1992 (EPACT). Motors not specified as “high efficiency” shall comply with EPACT.

D. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC).

E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

F. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees centigrade (104 degrees F); minimum horsepower as shown on drawings; maximum horsepower in normal operation not to exceed nameplate rating without service factor.

G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

2.5 ELECTRICAL REQUIREMENTS

A. Electrical work required to install and control electrical equipment which is not shown on plans or specified under sections in series 26000 shall be included in E/C's base bid proposal.

B. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which was not used for basis of design shall be paid for by E/C at no cost to Owner or A/E.

2.6 FIRESTOPPING

A. Provide an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping with a U.L. listed firestop material and in a U.L. listed assembly configuration. Submit material and assembly detail for review.

2.7 TOOLS AND LUBRICANTS

A. Furnish, and turn over to the Owner, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Coordinate location of piping, sleeves, inserts, hangers, and equipment, access provisions, and work of all trades. Locate piping, sleeves, inserts, hangers, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.

B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.

C. Cutting Holes:

1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed.
2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by A/E.
3. Do not penetrate membrane waterproofing.

D. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown, but must be provided.

E. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

F. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Engineer. Damaged or defective items in the opinion of the Engineer, shall be replaced.
2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water, chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

G. Concrete and Grout: Use concrete and shrink compensating grout 3000 psi minimum

H. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.

I. Inaccessible Equipment:

1. Where the A/E determines that the E/C has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY POWER AND EQUIPMENT

A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.

B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities.

C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

D. All temporary shut-downs of service shall be coordinated with the owner and other trades as needed to maintain operating service in the facility. Off-hours work is normally needed to accomplish these and shall be included in the contract.

3.3 RIGGING

A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.

B. Alternative methods of equipment delivery may be offered by E/C and will be considered by A/E under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.

C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for operation and maintenance of service.

D. E/C shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.

3.4 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Owner, equipment and systems shall be thoroughly cleaned and painted.

B. In addition, the following special conditions apply:

1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
2. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
3. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

3.5 STARTUP AND TEMPORARY OPERATION

A. Start up equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation.

B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.

C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

END OF SECTION 260500

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SECTION 260519 - CONDUCTORS AND CABLES

PART 1 - GENERAL (Reference Section 260500)

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Unless noted otherwise conductors referred to are wires and cable. Provide code grade soft annealed copper conductors with specified insulation type in proper colors to conform with color coding specified. Provide conductors No. 8 gauge and larger stranded and conductors No. 10 gauge and smaller may be solid or stranded.

B. Use no conductors smaller than No. 12 gauge unless specifically called for or approved by Engineer. Size wire for 120 volt branch circuits for 3% maximum voltage drop. Size feeder circuits for 2% maximum voltage drop. Combined voltage drop of feeders and branch circuits shall not exceed 5% maximum. In no case shall feeders and wires be smaller than that shown on plans.

C. Lighting and Receptacle Circuits: Type THHN/THWN, 600 volt, 75 degrees C (167oF) copper thermoplastic insulated building conductor. Romex wiring (Type NM), copper, may be used for all branch circuiting where allowed by Code and local jurisdiction.

D. Feeders: Type AA8000 compact aluminum alloy may be used for feeders of #1 and above or as noted on the drawings. Sizes shall meet ampacity requirements of the overcurrent protection and voltage drop.

E. Provide conductors by Anaconda, General Cable, General Electric, Phelps Dodge, or equivalent.

2.2 CONDUCTOR INSTALLATION

A. Run conductors in conduit continuous between outlets and junction boxes with no splices or taps.

B. Neatly route, tie and support conductors terminating at switchboards, motor control centers, panelboards, sound equipment, etc., with Thomas & Betts Ty-Rap cable ties and clamps or equivalent by Panduit.

C. Make circuit conductor splices with Buchanan crimped-on solderless connectors and snap-on nylon insulators or equivalent.

D. Make fixture and device taps with Scotchlok self-stripping electrical tap connectors.

E. Terminate solid conductors at equipment terminal strips and other similar terminal points with insulted solderless terminal connectors. Terminate all stranded conductor

terminal points with insulated solderless terminal connectors. Provide Thomas & Betts Sta-Kon insulated terminals and connectors or equivalent by API/AMP, Blackburn, Buchanan or Scotchlok.

F. Where a total of six or more control and feeder conductors terminate in a multiple device panel or enclosure that has no built-in terminal blocks provide Buchanan 600 volt heavy duty Type HO sectional terminal blocks with mounting channel and No. 23 see-thru covers. Equivalent terminal blocks by General Electric, Square D or Westinghouse.

G. Wrap conductor taps and connections requiring additional insulation with a minimum of three overlapped layers of 3M scotch vinyl plastic electrical type No. 88 or equivalent.

2.3 CONDUCTOR COLOR CODING

A. Provide continuous color coding for feeder, branch and control circuits. Insulation or identification tape color shall be same color for like circuits throughout. Where specified insulation colors are not available in larger wire sizes color code conductor at all accessible locations with Scotch 35 all-weather color code tape.

B. Identify the same phase conductor with same color throughout.

C. Provide conductors with color coding indicated. Where more than one standard voltage system is installed provide same colored conductors with indicated tape or stripe to indicate system voltage.

2.4 OPENINGS, ACCESS PANELS AND SLEEVES

A. This contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. E/C shall set and verify the location of sleeves as shown on structural plans that pass through beams, only if so shown. All floor penetrations be sealed to meet fire rating requirements.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 260519

SECTION 260526 - GROUNDING

PART 1 - GROUNDING

1.1 GENERAL REQUIREMENTS

A. Supplement grounded neutral of secondary distribution system with equipment grounding system, installed so that metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items operate continuously at ground potential and provide low impedance path for ground fault currents.

B. System shall comply with National Electrical Code, modified as indicated on drawings and as specified.

PART 2 - PRODUCT (Not Applicable)

PART 3 - EXECUTION

3.1 GROUNDING CONNECTIONS

A. Provide equipment ground bus in base of low voltage, main distribution equipment brazed or otherwise adequately connected by an approved method to at least three 3/4" diameter by 10'-0" long ground rods. Where required, to meet requirement of specified tests, extra rods shall be installed at no additional cost to Owner. Rods shall be located a minimum of 6 feet from each other or any other electrode and shall be interconnected by a minimum 4/0 bare copper conductor brazed to each ground rod below grade.

B. Provide #4 bare copper conductor properly connected to not less than 20 linear feet of additional #4 bare copper conductor located within and near the bottom of a concrete foundation that is in direct contact with earth. Provide a minimum of 2" concrete cover over the grounding electrode.

C. Connect system neutral ground and equipment ground system to common ground bus.

D. Ground secondary services at supply side of each individual secondary disconnecting means and at related transformers in accordance with National Electric Code. Provide each service disconnect enclosure with neutral disconnecting means which interconnects with insulated neutral and uninsulated equipment ground sub to establish system common ground point. Neutral disconnecting links shall be located so that low voltage neutral bar with interior secondary neutrals can be isolated from common ground bus and service entrance conductors.

E. Required equipment grounding conductors and straps shall be sized in compliance with N.E.C. Table 250-95. Equipment grounding conductors shall be provided with green type TW 600 volt insulation. Related feeder and branch circuit grounding conductors shall be connected to ground bus with approved pressure connectors. Provide feeder servicing several panelboards with a continuous grounding conductor connected to each related panelboard ground bus. Aluminum conductors, straps or bars may be

substituted for copper items if consistent with materials used for phase conductors. Substitute materials shall be comparable in current carrying capacity, temperature rise, and mechanical strength. Installation shall include necessary precautions regarding terminations with dissimilar metals.

F. Provide low voltage distribution system with a separate green insulated equipment grounding conductor for each single or three-phase feeder. Single phase 120 and 277 volt branch circuits for lighting and power shall consist of phase neutral and grounding conductors installed in common metallic conduit. Provide flexible metallic conduit utilized in conjunction with above single phase branch circuits with continuous suitable green insulated grounding conductors. Install grounding conductor in common conduit with related phase and/or neutral conductors. Where parallel feeders are installed in more than one raceway, each raceway shall have a green insulated equipment grounding conductor.

G. Contractor shall determine number and size of pressure connectors to be provided on equipment grounding bars for termination of equipment grounding conductors in panelboards and other electrical equipment. In addition to active circuits, provide pressure connectors for panel spares and blank spaces.

H. Provide electrical expansion fitting with an external flexible copper ground securely bonded by approved grounding straps on each end of fitting except where UL approved built-in copper grounding device is provided.

I. Provide steel and aluminum conduits which terminate switchboards, panelboards, motor control centers, motor starters and disconnect switches to metallic housing of electrical equipment with ground bushing and connect each bushing with bare copper conductor to ground bus in electrical equipment.

3.2 GROUNDING TEST

A. Test complete equipment grounding system at each service disconnect enclosure ground bar with Vibroground test unit manufactured by Associated Research Inc. Resistance, without chemical treatment or other artificial means shall not exceed fifteen (15) ohms to ground.

B. Electrical Contractor shall oversee grounding tests at successful completion of installation of grounding system and shall submit certified test reports of ground tests to Architect-Engineer.

END OF SECTION 260526

SECTION 260533 - RACEWAYS AND BOXES

PART 1 - GENERAL

PART 2- PRODUCTS

2.1 STEEL CONDUIT

A. Galvanized rigid steel conduit: Conduit shall be hot dipped galvanized and shall bear an U.L. label. Conduit shall also meet Federal Specification W-WC-581 and ANSI C80.1.

B. IMC Conduit: Conduit shall be galvanized intermediate metal conduit manufactured in accordance with UL 1242 and meeting the requirements of Federal Specification WWC-501.

C. EMT Conduit: Conduit shall be galvanized steel electrical metallic tubing and bear an Underwriters' Laboratory label. Conduit shall conform to Federal Specification WWC-563 and ANSI specification C80.3.

D. Contractor may use either rigid steel, IMC or EMT for all circuiting. Clubhouse wiring shall be EMT for all home runs and to first box or device where a transition to MC cable may occur.

E. Flexible Conduit: Flexible conduit shall have a water resistant non-sleeving polyvinyl chloride jacket with a general temperature range of -40 degrees C to +60 degrees C. Conduit shall bear an UL label.

F. Flexible conduit lengths of 4' or more require review by Engineer. Contractor shall use flexible conduit for connections to motors and equipment mounted on resilient mounts or vibration isolators. MC cable may be used in gypsum board walls between outlets.

G. PVC Conduit - Schedule 40 PVC by Carlon can be used below slab or grade. Flexible PVC conduit (Smurf pipe) may be used if local code allows for telecom and CATV cabling.

2.2 FITTINGS

A. Rigid Steel and IMC Conduit: Couplings shall be steel threaded type and box connectors shall be malleable iron insulated grounding bushings and malleable iron or steel locknuts. Unilets shall be malleable iron with blank cover.

B. EMT Conduit: Couplings shall be steel or malleable iron set screw type. Box connectors shall be malleable iron and malleable iron or steel locknuts. Unilets shall be malleable iron with blank cover.

C. Flexible Conduit: Connector shall be steel or malleable threaded type iron with grounding ferrule and insulated throat.

D. Where conduits cross building expansion joints provide O-Z expansion fittings type "AX", "TE", "EX", or "EXE" as required.

2.3 PLASTIC CONDUIT

A. Provide rigid polyvinyl chloride (PVC) type EPC 40 heavy wall plastic conduit meeting current NEMA Standard TC-2. Conduit shall be listed UL 651 for underground and exposed use.

B. Plastic conduit may only be used for exterior underground applications or circuits beneath slabs on grade except as noted. Provide EMT radius bends and risers for conduits above 1" that rise above grade/slab.

C. Provide exterior underground conduit with metal detection strip.

D. Provide matching plastic fittings. Fittings shall meet the same standards and specifications as the conduit on which it is installed.

E. Joining and bending of conduit and installation of fittings shall be done only by methods recommended.

F. Provide conduit support spacing as recommended for the highest ambient temperature expected.

G. Provide interlocking conduit spacers for multiple runs of underground conduits installed in same trench.

H. Provide expansion couplings on long runs regardless of ambient temperatures. Determine amount of conduit expansion and contraction from published charts or tables.

I. Plastic conduit and fittings shall be by a Products Division of Continental Oil Company.

2.4 OUTLET BOXES

A. Provide electrical service outlets, including plug receptacles, lamp receptacles, lighting fixtures and switches with Steel City, Raco, or equivalent. Thermoset fiberglass knockout boxes of required depth for service or device may be used within apartment units. Steel boxes to be used in exposed areas such as the garage. PVC or steel may be used in other Common areas.

2.5 LOCATION OF OUTLET BOXES

A. Locate outlet boxes generally from column centers and finished wall lines. Install ceiling outlet boxes at suspended ceiling elevations. Install all boxes according to ADA requirements.

B. Accurately locate lighting fixtures and appliance outlet boxes mounted in concrete or in plaster finish on concrete. Install outlet boxes in forms to dimensions taken from bench

marks, columns, walls, or floors. Rough-in lighting fixtures and appliance outlet boxes to general locations before installation of walls and furring and reset to exact dimensions as walls and furring are constructed. Set outlet boxes true to horizontal and vertical finish lines of building.

C. Install outlet boxes accessible and according to ADA. Provide outlet boxes above piping or ductwork with extension stems or offsets as required to clear piping and ductwork. Boxes for ceiling fans shall be rated as such.

D. Install bottom of switch outlet boxes 48" above floor unless otherwise called for or required by Wainscot, Counter, etc. Install bottom of receptacle outlet boxes 16" above floor unless otherwise called for on drawings.

E. Install outlet boxes at elevations indicated on drawings or as directed by Architect. Center bracket lights over mirrors with 2" clearance above mirror. Thermostats shall be 48".

F. See architectural drawings for specific accessible mounting heights.

2.6 PULL BOXES, WIREWAYS AND GUTTERS

A. Provide Alwalt, Keystone, Universal or equivalent code gauge pull boxes, wireways, and gutters indicated or required for installation, sized to conform with NEC rules. Provide complete with necessary fittings, interconnecting nipples, insulating bushings, conductor supports, covers, gaskets, partitions, etc. as required.

B. Special items may be fabricated locally, to same general design and specifications as those listed in specified manufacturer's catalogs. Provide free of burrs, sharp edges, unreamed holes, sharp pointed screws or bolts, and finished with one coat of suitable enamel inside and out, prior to mounting.

C. Provide sectional covers for easy removal.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION

A. In general conceal conduit within walls, floors, roof construction or furred spaces. Expose only feeder and short connections to equipment in equipment rooms unless noted otherwise. Install exposed conduit parallel or at right angle to building lines.

B. Install conduit to requirements of structure, other work on project and clear of openings, depressions, pipes, ducts, reinforcing steel, etc. Install conduit in concrete forms so that strength of structure will not be affected.

C. Align conduit terminations at panelboards, switchboards motor control equipment, junction boxes, etc. and install true and plumb. Provide supports or templates to hold conduit alignment during rough-in stage of work.

D. Install conduit continuous between outlet boxes, cabinets and equipment. Make bends smooth and even without flattening or flaking conduit. Radius of bends shall not be shorter than radius listed table 346-10 (b) of NEC. Long radius elbows may be used where necessary.

E. Ream and clean conduit before installation and plug or cover openings and boxes to keep conduit clean during construction.

F. Install no conduits or other raceways sized smaller than permitted in applicable NEC Tables. Where conduit sizes shown on drawings are smaller than permitted by code, Contractor shall include cost for proper size conduit in his base bid. In no case reduce conduit sizes indicated on drawings or specified without written approval of Architect-Engineer. Fasten conduit securely in place with approved straps, hangers, and steel supports. Provide O-Z cable support to support conductors in vertical raceways as required by NEC Table 300-19 (a) of NEC.

3.2 INSERTS, HANGERS

A. Support vertical and horizontal conduit runs at intervals not greater than 10 feet, within 3 feet of any bend and at every outlet or junction box. Where plastic conduit is used follow manufacturer's recommended hanger spacing.

B. Install multiple runs of conduits as follows:

1. Where a number of conduits are to be run exposed and parallel, group and support with trapeze hangers.
2. Fasten hanger rods to structural steel members with suitable beam clamps and to concrete structures with inserts set flush with surface. Install concrete inserts with reinforced rod through opening provided in inserts.
3. Inserts shall be Grinnell figure 279, 281, 282, or 285 or equivalent as required by load and concrete thickness.
4. Provide beam clamps suitable for structural members and conditions.
5. Provide 3/8" minimum diameter steel hangers rods galvanized or cadmium plated finish.
6. Trapeze hangers shall be Kindorf Series 900 channel with fittings and accessories as required.
7. Attach each conduit to trapeze hanger with Steel City No. C-105 clamps for rigid conduit and Steel City No. C-106 clamps for electrical metallic tubing. (EMT).

C. Install clamps for single conduit runs as follows:

1. Support individual runs by approved pipe straps, secured by toggle bolts on hollow masonry; expansion shields and machine screws or standard preset inserts on concrete or solid masonry; machine screws or bolts on metal surfaces; and wood screws on wood construction. Use of perforated strap not permitted.

2. Install exposed conduits in damp locations with clamp backs under each conduit clamp to prevent accumulation of moisture around conduits.

D. Provide inserts, hangers and accessories with finish as follows:

1. Galvanized: Concrete inserts and pipe straps.
2. Galvanized or Cadmium Plated: Steel bolts, nuts, washers and screws.
3. Painted with Prime Coat: Individual hangers, trapeze hangers and rods.

E. Equivalent hangers and support systems by Binkley, Fee and Mason, Kin-Line or Unistrut.

3.3 BUSHINGS AND LOCKNUTS

A. Enter outlet boxes squarely and securely clamp conduit to outlet box with bushing on inside and locknut on outside. Provide Thomas and Betts 3800, Efcor 56 series or equivalent threaded malleable iron insulated throat grounding bushings.

B. Terminate metallic conduits at switchboards, panelboards, control cabinet, etc. with O-Z Electrical Manufacturing Company Type "BL" or "IGB" grounding type insulating bushings. Ground bushings to equipment grounding buss.

3.4 SLEEVES

A. Furnish proper type and size sleeves to General Contractor for electrical ducts, busses, conduits, etc. passing through building construction. Supervise installation to insure proper sleeve location. Unless indicated or approved install no sleeves in structural members.

B. All holes or voids created by the electrical contractor to extend pipe through fire rated floors and walls shall be sealed with an intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures of 250 degrees F. It shall be ICBO, BOCAI and SBCCI (NRB 243) approved ratings to 3 hours per ASTM E-814 (UL 1479). Acceptable Material: 3M Fire Barrier Caulk, Putty, Strip and sheet forms.

END OF SECTION 260533

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SECTION 262400 – PANELBOARDS AND SWITCHBOARDS

PART 1 - GENERAL

1.1 Provide distribution and power panelboards as indicated in the panelboard schedule and where shown on the plans. Panelboards shall be equipped with thermal-magnetic case circuit breakers of frame and trip ratings as shown on the schedule.

PART 2 - PRODUCTS

2.1 CIRCUIT BREAKER PANELBOARDS

A. Provide dead-front panelboards with bolt-in molded case circuit breakers as listed in schedule. Panelboards shall conform to NEMA Standard Publication No. PB-1 and UL Standards No. 50 & 67 for panelboards.

B. Boxes shall be galvanized steel standard width and depth except where scheduled otherwise. Fronts shall be code gauge steel finished with rust-inhibiting primer and baked enamel finish. Fronts shall have flush doors with flush cylinder tumbler type locks, spring-loaded door pulls, concealed door hinges. Provide doors higher than 48" with three point catch. Panel door locks shall be keyed alike. Provide fronts designed for flush or surface mounting as indicated and attached to box by adjustable trim clamps.

C. Provide tin-finished aluminum bars full length of panel with rating listed in schedule. Bus bar connection to branch circuit breakers shall be "Phase Sequence" type designed and assembled so circuit breakers can be replaced without disturbing adjacent breakers or removing main bus or branch circuit connectors. Provide bus bars with wire lugs suitable for copper or aluminum conductors. Provide each panel with equipment grounding bus grounded to box and neutral bus insulated from box.

D. Branch circuit breakers shall be quick-make, quick-break with trip indication. Circuit breakers shall operate both manually for normal switch functions and automatically under overload and short circuit conditions. They shall provide circuit and self-protection when applied within their rating. Operating mechanisms shall be entirely trip free so that contacts cannot be held closed against a short circuit. Operating handle of circuit breaker shall open and close all poles of a multi-pole breaker simultaneously and conform to NEMA Standards Publications No. PB-1 and be approved by UL. Circuit breaker shall have a thermal magnetic trip unit for each pole for inverse time delayed overload protection and an instantaneous magnetic element for short circuit protection. Trip elements shall operate a common internally connected trip bar to open all poles in case of overload or short circuit through any one pole. Panel shall provide for branch circuit breakers, shall be up to 100 amperes, and unless indicated otherwise shall have 10,000 RMS (120/208V) short circuit amperes symmetrical interrupting capacity or as listed in the schedules. Breakers shall be one, two or three pole type as indicated in panel schedule.

E. Panels shall have branch circuit directory holders with clear plastic cover. Provide neatly typed list of branch circuit loads corresponding to branch circuit numbers.

F. Panels shall have branch circuit directory holders with clear plastic cover. Provide neatly typed list of branch circuit loads corresponding to branch circuit numbers.

G. Panelboards for apartments shall be Square "D" QO and Square “D” NQOD for all others 400 A and less (common areas).

H. See panelboard schedules

2.2 DISTRIBUTION PANELBOARDS

A. Bussing Assembly and Temperature Rise

1. Panelboard copper bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50°C rise above ambient. Heat rise tests shall be conducted in accordance with Underwriters Laboratories Standard UL 67. The use of conductor dimensions will not be accepted in lieu of actual heat tests. Provide isolated ground bus.

B. Circuit Breakers

1. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front face of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position. Tripped indicated shall be clearly shown by the breaker handle taking a position between "ON" and "OFF". Provisions for additional breakers shall be such that no additional connectors will be required.

C. Integrated Equipment Short Circuit Rating

1. Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or on the plans. This rating shall be established by testing with the overcurrent devices mounted in the panelboard. The short circuit tests on the overcurrent devices and on the panelboard structure shall be made simultaneously by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. Method of testing shall be per Underwriters Laboratories Standard UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Testing of panelboard overcurrent devices for short circuit rating only while individually mounted is not acceptable. Also, testing of the bus structure by applying a fixed fault to the bus structure alone is not acceptable. Panelboards shall be marked with their maximum short circuit rating at the supply voltage and shall be UL listed.

D. Cabinet

1. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. The size of wiring

gutters shall be in accordance with UL Standard 67. Cabinets to be equipped with latch and tumbler- type lock on door of trim. Doors over 48" long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike. Endwalls shall be removable. Fronts shall be of code gauge steel. Gray baked enamel finish electrodeposited over cleaned phosphatized steel.

E. Safety Barriers

1. The panelboard interior assembly shall be dead front with panelboard front removed. Main lugs or main breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

F. Panelboards shall be I-line from Square D.

2.3 UL LISTING

A. Panelboards shall be listed by Underwriters Laboratories and shall be the UL label. When required, panelboards shall be suitable for use as service equipment.

2.4 EQUIVALENT BY CUTLER HAMMER, ITE, G.E.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 262400

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SECTION 262726 - SWITCHES, RECEPTACLES AND COVER PLATES

PART 1 - GENERAL (Not applicable)

PART 2 - PRODUCTS

2.1 QUALITY ASSURANCE

A. N.E.C. Compliance - Comply with the N.E.C. as applicable to construction installation of electrical wiring devices.

B. U.L. Compliance and Labeling - Provide electrical wiring devices which have been U.L. listed and labeled.

C. N.E.M.A. Compliance - Comply with the N.E.M.A. standards for general and specific purpose wiring devices.

D. Provide factory fabricated wiring devices, in types, colors and electrical ratings for applications indicated and complying with N.E.M.A. standards. Where types and grade are not indicated, provide proper selection as determined by the installer and approved by the owner to fulfill the wiring device requirements. Provide gray colored devices except as otherwise selected by the architect and verified by the owner.

2.2 ACCEPTABLE MANUFACTURES

A. Provide products produced by one of the following manufactures:

Hubbell Inc.	Steel City
Pass & Seymour	Midland Ross
Leviton	Raceway Components

2.3 RECEPTACLES

A. Duplex Receptacles – For all areas except within apartments provide specification grade, single outlet, 20 amp, 125 volt, N.E.M.A. configuration 5-20R receptacles with high impact ivory nylon faces, back and side wired, heavy duty triple wipe "T" contacts. Hubbell 5351, P&S 5361, Lev. 5361.Within apartments provide residential grade, 15 amp (20 amp for dedicated circuits), 125 volt, N.E.M.A. configuration 5-15/20R receptacles. With high impact ivory faces, back and side wired. Devices shall be tamper-proof where required by Code: Hubbell RR15SITR, RR201ITR

B. Isolated Ground Receptacles - Provide specification grade, 20 amp, 125 volt, N.E.M.A. configuration 5-20R duplex receptacles. Shall have the isolation method as an integral part of the device, high impact orange nylon face, back and side wired, heavy duty triple wipe "T" contacts. Hubbell IG5362 or approved equal.

C. Surge Suppression Duplex Receptacles - Provide specification grade, 20 amp, 125 volt, N.E.M.A. configuration 5-20-R Surge Suppression receptacles. With three mode protection, both visual and audible indicators, high impact blue nylon face. Hubbell 5352-S or approved equal.

D. Illuminated Receptacles - Provide specification grade, 20 amp, 125 volt, N.E.M.A. configuration 5-20R duplex receptacles. With illuminated high impact nylon faces and heavy duty triple wipe "T" contacts. Hubbell 5362IL or approved equal.

E. Ground Fault Receptacles - Provide specification grade, 20 amp, 125 volt, ground fault circuit interrupter duplex receptacles. With a 5 milliampere trip level, feed-thru type, capable of protecting connected downstream receptacles. Hubbell GFTR20I.

F. Weatherproof Convenience Outlets - Duplex receptacles needing to be weatherproof shall be supplied with an aluminum cover with two spring held covers, one over each outlet and each with a rubber watertight gasket. Hubbell 525WO, P&S WPD-8, standard box mounting. Hubbell 5206WO, P&S 4510, FS/FD box mounting. Provide flush in-use boxes with clear plastic covers by Arlington.

GFCI receptacles use Hubbell CWP26H, P&S WPH-26, standard box mounting. Hubbell WPFS26, P&S 4511, FS/FD box mounting.

G. Combination USB and Receptacle – Provide Leviton #T5630-W 15 amp combination ivory receptacle and USB Charger. 15 Amp, 125 Volt, tamper-resistant, NEMA 5-15R. 2.1 Amp, 5VDC, 2.0/3.0 Type A USB Chargers. Grounding, Side Wired & Back Wired - Ivory.

2.4 SWITCHES

A. Single Pole - Provide specification grade, single pole, 20 amp, 120-277 volt, AC ivory quiet type switches. Equipped with mounting yoke insulated from the switching mechanism, color coded by amperage tops, back and side wired. Hubbell 121I, P&S 20AC1-I, Lev. 1221I.

B. Three-Way - Provide specification grade, three-way, 20 amp, 120-277 volt, AC quiet type ivory switches. Equipped with mounting yoke insulated from the switching mechanism, color code by amperage tops, back and side wired. Hubbell 1223I, P&S 20AC3-I, Lev. 1123I.

2.5 COVER PLATES

A. Provide cover plates for all wiring devices. Plates must be compatible with the wiring devices. Provide blank plates as required.

B. Cover plates for switches, convenience outlets, blank outlets, telephone, etc....shall be smooth ivory plastic.

C. Cover plates in unfinished areas shall be galvanized steel.

D. Labeled plates shall be permanently engraved with appropriate lettering.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine areas and conditions under which wiring devices are to be installed and notify the general contractor in writing of conditions detrimental to proper and timely completion of the work. Do no proceed with the work until unsatisfactory conditions have bee corrected in a manner acceptable to the installer.

3.2 INSTALLATION OF WIRING DEVICES

A. Install wiring devices as indicated, in compliance with manufacturers written instructions, applicable requirements of N.E.C. and N.E.M.A. standards in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical box and wiring work as necessary to interface installation of wiring devices.

C. Install wiring devices only in electrical boxes which are clean, free from excess building materials, dirt and debris.

D. Install wall mounted receptacles with the ground slot up. Install floor receptacles parallel to the adjacent wall.

E. Delay installation of wall plates until painting work is completed.

F. Upon installation of wall plates and receptacles, advise contractor regarding proper and cautious use of convenience outlets. At time of completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.3 TESTING

A. Testing - Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 262726

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SECTION 262813 - OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

PART 2 - PRODUCT

2.1 FUSES

A. Provide fuses of same manufacturer and characteristics as scheduled to insure selective coordination of power system. All fuses shall be listed by Underwriters Laboratories, Inc. with an interrupting rating of 100,000 amperes R.M.S. symmetrical.

B. Install fuses only after installation is complete and final tests and inspections have been made. Label fuses, switches and other fused devices with warning labels affixed in prominent location indicating type and size of fuse installed and fuse manufacturer's catalog number.

C. Fuses 600 amp and below shall be U/L Class dual element, time delay sized as shown on drawings or schedules.

D. Special temperature conditions, motors, motor loads or other conditions requiring other types or sizes of fuses must be reviewed by the Engineer. Fuse reducers are not permitted.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 262813

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SECTION 262816 - METER CENTERS AND DISCONNECT SWITCHES

PART 1 - GENERAL

PART 2 - PRODUCT

2.1 METER CENTERS

A. Provide meter centers complete, as intended and as shown on plan for outdoor usage and in coordination with power company.

B. Provide Square D EZ Meter-Pak, rainproof as shown on risers with main where shown and individual main breakers to units.

C. Bus shall be 65,000 minimum AIC. Tenant breakers shall be 65,000 minimum AIC.

D. Equivalent by Cutler-Hammer, ITE, G.E.

2.2 DISCONNECT SWITCHES

A. Provide heavy duty horsepower rated Safety Switches rated in accordance with NEMA enclosed Switch Standard KS 1-1969 and L98 Standard.

B. Enclosure shall be NEMA type required by switch location and environment. Enclosure door shall latch with means for padlocking and cover interlock with defeater to prevent opening door when switch is energized or closing switch with door open. Switch shall have an embossed nameplate permanently attached to door front with switch rating, short circuit interrupting capacity and application information.

C. Line terminals shall be permanently marked and shielded. Contact shall be tin plated, equipped with arch chutes and have moving contacts visible in off position with door open. Wiring terminals shall be pressure type suitable for copper or aluminum wire. Switching mechanism shall be quick-make, quick-break spring driven anti-tease mechanism and be integral part of box. All current carrying parts shall be plated.

D. Fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required. Fuse holders shall be completely accessible from front of switch.

E. Provide switches by Square "D", Cutler Hammer, ITE, G.E.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 262816

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SECTION 265100 - LIGHTING

PART 1 - GENERAL (Reference 260500)

PART 2 - PRODUCTS

2.1 LAMPS

A. Fixture lamps shall be lamp type recommended by fixture manufacturer. Lamp no fixtures above manufacturers recommended maximum wattages.

B. Equivalent lamps by Venture, Phillips or Sylvania.

2.2 LAMP BALLASTS

A. Fluorescent fixture ballast shall be Advance Discrete electronic type with 10% THD max. Ballasts shall have sound rating indicated on ballast case and rated as follows:

BALLAST TYPE	SOUND RATING
Pre-Heat - Rapid Start	A
Trigger Start	A
Instant Start	B
High Output	C

Provide VLH-Es ballasts where light fixtures are located in a fire rated ceiling.

B. Ballast for exterior lighting or in areas where fixtures are required to operate below 50 degrees F (i.e., coolers and freezers) shall have ballasts designed for low ambient operation.

C. Equivalent by Motorola, Universal.

2.3 FIXTURES

A. General Requirements

1. Provide fixtures complete with lamps and accessories required for hanging. Contractor shall insure that lamps, reflector lens and trim are clean at time of final inspection. Mount recessed fixtures with trim flush to ceilings, fee of gaps or cracks.
2. Coordinate mounting of ceiling mounted luminaires with Contractor. Where additional fixture supports are required due to fixture location or weight, supports shall be provided by this Contractor, unless otherwise specified under ceiling specifications.

3. Consult architectural plans for ceiling types and provide surface and recessed fixtures with appropriate mounting components and accessories.
4. Where equivalent, manufacturers are listed in fixture schedule, fixtures by these manufacturers will be acceptable provided fixture submitted meets or exceeds specified fixtures in performance and construction and appearance.
5. Provide luminaires at each outlet shown on drawings. Fixture shall be in accordance with type designation on drawings.
6. Fixtures supports shall comply with NEC Sections 410-15 and 410-16. Provide fixture securing clips as required.
7. Luminaires which are recessed in one hour rated ceiling shall be fire retardant. Gypsum board enclosures meeting IBC, NEC and UL requirements shall be provided in rated ceilings per the architectural Code drawings.
8. See Luminaire Schedule.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 265100

SECTION 271000 - TELECOMMUNICATIONS

PART 1 - GENERAL SPECIFICATIONS

1.1 SCOPE

A. This document describes the products and execution requirements relating to furnishing and installing Voice, Data and CATV. Horizontal cabling comprised of copper, support systems are covered under this document.

B. The Horizontal (workstation) Cabling System shall consist of a minimum of 4-pair Unshielded Twisted Pair (UTP) Copper Cables to each work area outlet unless otherwise noted for specific locations. Cables shall be installed from the Work Area Outlet to the Telecommunications Room (TR). In the Telecommunications Room, they shall be routed to the appropriate rack and terminated as specified in this document.

C. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Telecommunications Contractor as detailed in this document and the project drawings.

D. Product specifications, general design considerations, and installation guidelines are provided in this document. Typical installation details, cable routing and outlet location and types will be provided on the project drawings, an attachment to this document. If the bid documents are in conflict, this specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cable system described in this document.

1.2 REGULATORY REFERENCES

A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, NEC, the local Electrical Code, authority having jurisdiction and present manufacturing standards.

B. All materials shall be UL Listed and shall be marked as such. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

C. The performance of all modular jacks, patch cords, consolidation points, and patch panels shall be Category 6 components and channel compliant and/or meet and adhere to the below defined standards.

D. The cabling system described in this is derived from the recommendations made in recognized telecommunications industry standards. The following documents are incorporated by reference:

1. ANSI/TIA/EIA - 568-B.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, May, 2001.

2. ANSI/TIA/EIA - 568-B.2, Commercial Building Telecommunications Cabling Standard Part 3: Balanced Twisted-Pair Cabling Components, June, 2002.
3. ANSI/TIA/EIA - 568-B.2-1, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted Pair Cabling Components, Addendum 1 – Transmission Performance Specifications for 4-pair 100 Ω Category 6 Cabling.
4. ANSI/TIA/EIA - 568-B.3, Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components, May, 2001.
5. ANSI/TIA/EIA – 569-A, Commercial Building Standard for Telecommunications Pathways and Spaces, February, 1998.
6. ANSI/TIA/EIA – 570-A, Residential Telecommunications Cabling Standard, October, 1999.
7. ANSI/TIA/EIA – 606 - A, Administration Standard for Telecommunications Infrastructure of Commercial Buildings, February, 2002.
8. ANSI/TIA/EIA – 607, Commercial Building Grounding and Bonding Requirements for Telecommunications, August, 1994.
9. ANSI/ TIA/EIA – 758, Customer-Owned Outside Plant Telecommunications Cabling Standard, April 1999.
10. BICSI - TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM) – 10th Edition, 2002
    a. National Fire Protection Agency (NFPA – 70), National Electrical Code (NEC) – 2002.

E. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

F. This document does not replace any code, either partially or wholly. The contractor is responsible for adherence of all codes, including local codes, and the authority having jurisdiction which may affect this project.

1.3 APPROVED CONTRACTOR

A. The Telecommunications contractor must have vendor approved and certified technicians that will install the cable system. A copy of certification documents must be submitted with the quote in order for such quote to be valid. The Telecommunications Contractor is responsible for workmanship and installation practices in accordance with the specific vendor solution that is proposed.

1.4 APPROVED PRODUCTS

A. Products are specified in this document and on drawings for the horizontal and backbone systems. Specific product and item numbers are defined in later sections of this document or on drawings. The telecommunications drawings indicate the associated part number/equivalent. Product and item numbers are defined in later sections of this document or indicated on the drawings. Approved manufacturers are:

1. Leviton
2. Hubbell

1.5 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor; equipment, materials, supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The Contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:

1. Furnish, install and terminate a complete communications infrastructure including wall plates, jacks patch panels, patch cords, cabinets and/or racks and any other material required to form a complete system.
2. Perform link testing (100% of horizontal and/or backbone links) and certification of all components.
3. Furnish two (2) sets of test results of all cabling to the Owner/Owner's Representative on compact disk and paper format, listed by each closet, then by workstation ID.
4. Adhere and comply with all requirements of the manufacturer of the products proposed in this specification.
5. Provide owner orientation of the overall cable system and cable system documentation. (As-built drawings)

1.6 SUBMITTALS

A. Under the provisions of this request for proposal, prior to the start of work the telecommunications contractor shall:

1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this specification.
2. Submit proof from manufacturer of contractor's good standing in manufacturer's program.
3. Submit appropriate cut sheets for all products, hardware and cabling if different from the products that are called out in this specification.
    a. Work shall not proceed without the Owner/Owner's Representative approval of the submitted items.
    b. The telecommunications contractor must receive written approval from the Owner/Owner's Representative on all substitutions of material. Substituted materials shall not be installed except by written approval from the Owner/Owner's Representative.

1.7 QUALITY ASSURANCE

A. The telecommunications contractor shall be a company specializing in communication cabling installation. Building Industry Consulting Services International (BICSI), or the proposed system solution vendor, must certify 30 percent of the termination crew for copper and 10 percent of the termination crew for fiber with a Technicians Level of Training.

1.8 STORAGE AND HANDLING

A. Cable shall be stored according to manufacturer's recommendations as a minimum. In addition, cable must be stored in a location protected from vandalism and weather. If necessary, cable shall be stored off site at the contractor's expense.

B. If the telecommunications contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner/Owner's Representative.

1.9 DRAWINGS

A. It shall be understood that the telecommunications details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the telecommunications contractor in bidding the job. The telecommunications contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.

B. The telecommunications contractor shall verify all dimensions and be responsible for there accuracy.

1.10 WARRANTY

A. The Warranty shall cover the failure of the wiring system to support the applications that are designed for the link/channel specifications of ANSI/TIA/EIA–568-B.2.1. These applications include, but are not limited to, 10BASE-T, 100BASE-T, 1000BASE-T, and 155 Mb/s ATM.

B. The contractor shall provide a warranty on the physical installation of not less the one year at no cost to the owner. Information with regard to the proper procedures to follow if needed should be included with the warranty. They should include but not be limited to; Contact Name, Contact Telephone Number, Project Reference, Anticipated Response Time.

1.11 FINAL ACCEPTANCE & SYSTEM CERTIFICATION

A. Final Acceptance of the implemented cable system solution will be provided in writing from the Owner / Owner's Representative. It will be issued upon successful completion of the installation, including but not limited to, final inspections, receipt of the successful test results and as-built documentation, and successful performance of the cabling system for a thirty-day period. Upon successful completion of the installation and subsequent inspection, the Owner/Owner's Representative shall be provided with a numbered certificate, from the Manufacturer of the installed system solution. This Extended Product Warranty shall be provided within thirty days of the completion of the project. Final payment will not be made until such warranty / numbered certificate is received.

PART 2 – PRODUCTS

2.1 WORK AREA OUTLETS

A. Work area cables shall each be terminated at their designated work area location in the connector types described in the subsections below. Included are modular telecommunication jacks. These connector assemblies shall snap into a faceplate from the front.

B. The Telecommunications Outlet Assembly shall accommodate:

1. The number of jacks as noted on the project drawings.
2. Additional accommodations for specific locations as noted in the plans for optical fiber and/or additional copper cables as necessary.
3. A blank filler module will be installed when extra ports are not used.
4. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Please refer to typical outlet configuration on project drawings prior to installation.

C. Printed labels shall be permanent and compliant with ANSI/TIA/EIA–606-B standard specifications. Labels shall be machine printed. Hand written labels shall not be accepted.

1. Faceplates: The faceplates shall:
   a. be constructed of molded plastic.
   b. be UL listed and/or match the color of the raceway if installed in surface raceway.
   c. be available as single-gang or dual-gang and provide for easy access for moves, adds and changes.
   d. provide designation field to facilitate labeling and identification.
   e. comply with ANSI/TIA/EIA-606-A work area labeling standard.
   f. be manufactured by an ISO 9001 registered company.

D. Voice / Data Jacks

1. Data jacks shall be 8-position modular jacks and shall meet or exceed Category 6 performance standards as defined by the references in this document. All pair combinations must be considered, with the worst-case measurement being the basis for compliance. Modular jack performance shall be third-party verified by a nationally recognized independent testing laboratory.
2. The modular jack shall be backwards compatible to Category 3, and 5.
3. The modular jack shall be center tuned to category 6 test specifications.

E. Video Jacks/Coax Connectors

1. Video jacks shall be “F” connectors and shall be installed in locations per the project drawing.

2.2 MODULAR PATCH PANELS

A. Modular Category 6 performance rated patch panels shall be used for the horizontal to terminate on. The panels shall be T568B standard, not high density, and use a standard 110-impact tool for termination.

B. 5E 66 blocks shall be used to terminate the voice cabling provided with bracket and wire spools.

2.3 WIRE MANAGEMENT PANELS

A. Cable management shall be provided above and below every 48 ports of patch / distribution panels or as shown on construction drawings. The wire management panels shall provide horizontal organization of patch cables on the rack.

B. Wire management panels shall also be required for every 48 ports of network electronics, (i.e. switches, hubs), installed in a rack.

2.4 RACKS

A. All equipment, patch panels, wiring blocks, etc., shall be mounted in self-supporting equipment as indicated on the project drawing. The rack shall be able to support 19" panels and equipment. The equipment rack shall provide vertical cable management and support for the patch cords at the front of the rack and wire management, support, and protection for the horizontal cables inside the legs of the rack. Waterfall cable management shall be provided at the top of the rack, on both sides, for patch cords and for horizontal cables entering the rack channels for protection and to maintain proper bend radius and cable support. The rack shall include mounting brackets for cable tray ladder rack to mount to the top of the rack. Velcro cable ties shall be provided inside the rack channels to support the horizontal cable. Rack(s) shall be black in color to match the patch panels, ladder rack, and cable management. Provide 12" ladder rack at top of racks and secure properly with j-bolts to rack and angle bracket on wall. Refer to "Rack Detail" on drawings for specific information.

2.5 HORIZONTAL DISTRIBUTION CABLE

A. All horizontal voice/data cabling must be rated Category 6. The horizontal cable shall be terminated on Category 6 modular patch panels as specified on the drawings. The horizontal cable must pass all Category 6 testing parameters upon completion of installation and termination.

2.6 COAX CABLE

A. RG-6 Coax cable shall be installed to provide for video service within the facility. It shall run from the respective Telecommunications Room to specific locations as indicated on the project drawings

2.7 GROUNDING AND BONDING

A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the

recommendations contained in the ANSI/TIA/EIA-607 Telecommunications Bonding and Grounding Standard.

B. The main entrance facility/equipment room in each building shall be equipped with a telecommunications main grounding bus bar (TMGB). Each telecommunications room shall be provided with a telecommunications ground bus bar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.

C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the TR or ER shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded green insulated copper bonding conductor and compression connectors, or as shown on drawings.

D. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Black insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labeled in accordance with the System Documentation Section of this specification.

2.8 FIRESTOP

A. A firestop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

B. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped.

C. Fire stop systems shall be UL Classified to ASTM E814 (UL 1479).

PART 3 – EXECUTION

3.1 WORK AREA OUTLETS

A. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12” of UTP and 36” of fiber slack shall be stored in an “in-wall” box, modular furniture raceway, or insulated walls. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

B. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B.1 document, manufacturer's recommendations, BICSI and best industry practices.

C. Pair untwist at the termination shall not exceed 12 mm (one-half inch).
D. Bend radius of the horizontal cable shall not be less than 4 times the outside diameter of the cable.

E. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.

3.2 HORIZONTAL DISTRIBUTION CABLE INSTALLATION

A. Cable shall be installed in accordance with recommendations from the manufacturer, BICSI and best industry practices.

B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

C. Cable raceways shall not be filled greater than the ANSI/TIA/EIA-569-A maximum fill for the particular raceway type or 40%.

D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points as noted on the project drawings. Additional splices, transition points or consolidation points must be approved in writing by the Owner / Owner's Representative.

E. Cables shall be routed to allow a minimum of three (3) feet of slack in a neat bundle, not coiled behind rack. This cable may be used for future rearrangements and re-terminations.

F. Where transition points, or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

G. J-hook or trapeze system shall be used to support cable bundles. All horizontal cables shall be supported at a maximum of 48 inch intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels or any other type of ceiling. They also shall not rest on tops of walls, duct work, or piping.

H. Horizontal distribution cables shall be bundled in groups of not more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

I. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

J. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.

K. Any cable damaged or exceeding recommended installation or test parameters during installation shall be replaced by the contractor before final acceptance at no cost to the Owner.

L. Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.

M. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the outside diameter of the cable at any point in the run and at the termination field. The cable's minimum bend radius shall not be exceeded.

N. Pulling tension on 4-pair UTP cables shall not exceed 25-lb. for a four-pair UTP cable. The cables maximum pulling tension shall not be exceeded.

O. The installation of cable shall conform to the following clearances:

1. At 5 inches (127 millimeters) form power lines carrying 2KVA or less.
2. At least 12 inches (305 millimeters) from power lines carrying from 2 to 5 KVA.
3. At least 36 inches (915 millimeters) from power lines carrying more than 5 KVA.
4. At least 2 inches (305 millimeters) from all fluorescent lights and other sources of electromagnetic interference such as electric motors, HVAC equipment, arc welders, intercoms, etc.

3.3 HORIZONTAL CROSS CONNECT INSTALLATION

A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B standard, manufacturer's and BICSI recommendations, and best industry practices.

B. Cable pair untwist at the termination shall not exceed 13 mm (0.5 inch).

C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

E. The cable jacket shall be maintained to within 25mm (1 inch) of the termination point.

F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

G. Racks shall be securely attached to the concrete floor using minimum 3/8" hardware or as required by local codes.

H. Racks shall be placed as shown on the construction drawings. When possible they shall be placed with a minimum of 36-inch clearance from the walls on all sides.

I. All racks shall be grounded to the telecommunications ground bus bar.

J. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

K. Wall mounted termination block fields shall be mounted on 4’ x 8’ x .75” void free plywood. The plywood shall be mounted vertically 12” above the finished floor. The plywood shall be painted with two coats of white fire retardant paint.

3.4 FIRESTOP SYSTEM

A. All fire stop systems shall be installed in accordance with the manufacturer’s recommendations and shall be completely installed and available for inspection by the local inspection authorities before cable system acceptance.

3.5 GROUNDING SYSTEM

A. The TBB shall adhere to the recommendations of the ANSI/TIA/EIA-607 standard, and shall be installed in accordance with best industry practice.
B. A licensed electrical contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground.

3.6 IDENTIFICATION AND LABELING

A. Labeling shall be done as shown on construction drawings. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the red-lined as-built drawings and all test documents shall reflect the appropriate labeling scheme. Labeling shall follow the guidelines of ANSI/TIA/EIA-606-A.

B. All label printing will be machine generated. Labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.

3.7 TESTING AND ACCEPTANCE

A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B system solution guidelines. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through

couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed at no cost to the Owner.

2. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, and the Manufacturer's Certification Program Information Manual, BICSI and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the Owner / Owner's Representative for clarification and resolution.
3. The Engineer may request that the T/C verify at random that the patch cords meet test requirements defined in ANSI/TIA/EIA-568-B.2.1.

B. Copper Link Testing

1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using a Level III test unit for category 6-performance compliance as specified in ANSI/TIA/EIA-568-B.2-1.
2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and/or replaced and re-tested before final acceptance.
3. Length - Each installed cable link shall be tested for installed length using a Time Domain Reflectometer (TDR) type device. The cables shall be tested from end to end, patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the longest pair length shall be recorded as the length for the cable.

C. Category 6 Performance

1. Follow the Standards requirements established in:

   a. ANSI/TIA/EIA-568-B .1, B.2-1
   b. A Level III test unit is required to verify category 6 performance. The basic tests required are:
      - Wire Map
      - Length
      - Attenuation
      - NEXT (Near end crosstalk)
      - Return Loss
      - ELFEXT Loss
      - Propagation Delay
      - Delay skew
      - PSNEXT (Power sum near-end crosstalk loss)
      - PSELFEXT (Power sum equal level far-end crosstalk loss)

D. Coax Cable Testing

1. 100% of coax cables placed shall be tested. They shall be tested for continuity and length. The results shall be recorded and provided to the Engineer for review.

3.8 SYSTEM DOCUMENTATION

A. Upon completion of the installation, the telecommunications contractor shall provide two (2) full documentation sets to the Owner / Owner's Representative for approval. Documentation shall include the items detailed in the sub-sections below.

B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test results and draft annotated drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. The telecommunications contractor shall provide copies of the original test results to the Owner / Owner's Representative.

C. The Owner / Owner's Representative may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Owner / Owner's Representative, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.9 TEST RESULTS

A. Test documentation shall be provided to the Owner / Owner's Representative within three weeks after the completion of the project. The telecommunications contractor shall provide one set of documentation, printed on paper and two copies on compact disk. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is mandatory on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

B. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-B including applicable TSB's and amendments. The appropriate Level III tester shall be used to verify Category 6 cabling systems.

C. Printouts generated for each cable by the (wire or fiber) test instrument shall be submitted as part of the documentation package. The telecommunications contractor must furnish this information in electronic form (CD-ROM) and print out on paper.

D. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

END OF SECTION 271000

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SECTION 282000 - ELECTRONIC SURVEILLANCE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to all Drawings and Specifications listed in Division 01 for additional requirements.

1.2 SUMMARY

A. The scope of work for this sub-contract shall include the installation and associated services for a fully operational IP base Video Surveillance System as per manufacturer's guidelines, codes described within this document, that provide central security management, integrated control of the intended site.

B. IP base video surveillance system shall be installed in the equipment rooms as indicated on the drawings, communicating to the over a local LAN connection. The system shall provide:

1. Provide all required power supplies.
2. Provide all cabling connections required.
3. Provide all specialty conduit requirements.

1.3 RELATED WORK

A. In addition to work described above, the Work shall include, but not necessarily be limited to, the following:

B. Equipment identification as indicated on drawings.

C. Providing all cabling, conduit and connections as required for complete and functional systems.

D. Providing 120 VAC uninterruptible power as required for all equipment provided under this contract.

E. Assemble equipment furnished disassembled in accordance with manufacturer's recommendations.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 20 years documented experience, and with a certified servicing organization within 150 miles of Project.

B. Installer: Company specializing in installing the Products specified in this section with minimum five years documented experience. Experience shall include projects with surveillance systems of similar scope and magnitude. Company shall be a Certified by the product manufacturer.

1.5 MATERIALS AND EQUIPMENT SUBSTITUTION

A. Material and equipment installed under this contract shall be first class quality, new, unused and without damage. The intent of these specifications is to allow ample opportunity for Contractor to use ingenuity and ability to perform the work to his and Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.

B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.

C. In general, these specifications identify required materials and equipment by naming first the manufacturer whose product was used as the basis for the project design and specifications. The manufacturer's product, series, model, catalog and/or identification numbers shall set quality and capacity requirements for comparing the equivalency of other manufacturer's products. Where other manufacturer’s names are listed they are considered an approved manufacturer for the product specified, however; the listing of their names implies no prior approval of any product they may propose to furnish as equivalent to the first named product unless specific model or catalog numbers are listed in these specifications or in subsequent addenda. Where other than first named products are used for Contractor base bid proposal it shall be the responsibility of the Contractor to determine prior to bid time that the proposed materials and equipment selections are products of approved manufacturers which meet or exceed the specifications and are acceptable to the Engineer.

D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review and approval prior to procurement.

E. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications, they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.

F. Materials and equipment proposed for substitution shall be equal to or superior to that specified in construction efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access, forward two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.

G. Within 10 working days after bids are received, apparent low bidder shall submit to A/E for approval three copies of a list of all major items of equipment he intends to provide. As soon as practicable and within 3 working days after award of contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work for Architect/Engineer's review. Where 30 working day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certifications that order was placed within 30 working day limit.

1.6 DRAWINGS, OPERATION AND MAINTENANCE INSTRUCTIONS

A. Contractor shall furnish a minimum of two (2) sets of shop drawings of all materials and equipment. Architect/Engineer will retain one (1) set.

B. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, sizes, etc., that are to be provided. Mark each submitted item with applicable section and paragraph numbers of these specifications, or plan sheet number when item does not appear in specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each submittal shall contain at least two (2) sets of original catalog cuts. Each catalog sheet shall bear equipment manufacturer’s name, address and phone number. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

C. Contractor shall check all shop drawings to verify that they meet specifications and/or drawing requirements before forwarding submittals to the Architect/Engineer for their review.

D. All shop drawings submitted to Architect/Engineer shall bear Contractor's approval stamp which shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: telecommunications and electrical characteristics, provisions for supply, and drainage connections to building systems. All shop drawings not meeting contractor's approval shall be returned to supplier for re-submittal.

E. No shop drawing submittals will be considered for review by the Architect/Engineer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of contractor's review.

F. Architect/Engineer will not be responsible for or the cost of returning shop drawing submittals that are submitted to them without Contractor's review and approval stamp.

G. Architect/Engineer's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless such deviations have been specifically approved in writing by Owner or the representative, nor shall it relieve Contractor of responsibility for error in shop drawings. No work shall be fabricated until

A/E's review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be Contractor's responsibility.

H. Submit with shop drawings of equipment, two (2) sets of operating and maintenance instructions and parts lists for all items of equipment provided. Instructions shall be prepared by equipment manufacturer.

I. Keep in safe place, keys and wrenches furnished with equipment under this contract. Present to Owner and obtain receipt for same upon completion of project.

J. Prepare a complete brochure, covering systems and equipment provided and installed under his contract. Submit brochures to Architect/Engineer for review before delivery to Owner. Contractor at his option may prepare this brochure or retain an individual to prepare it for him. Include cost of this service in bid. Brochures shall contain following:

1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined under Section this specification.
2. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
3. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of system.

K. Provide brochure bound in black vinyl three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:

1. Project name and address.
2. Section of work covered by brochure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. LTS. Or approved equal.

B. Provide High Performance Network Disk Recorder for LTS IP-based video surveillance cameras.

2.2 NETWORK DISK RECORDER

A. The LTN7732-P16 recorder shall be capable of connecting to up to 32 network cameras without extra license fees and the images can be recorded simultaneously with 16-channel simultaneous playback.

B. The recorder shall be equipped with 8 TB or storage.

C. The recorder shall support MPEG-4 and JPEG multi format.

D. The recorder shall provide Various Recording Mode: Manual, Schedule, Event (Pre/Post), Emergency, and External Timer. It shall have the capabilities to control: Pan/Tilt, Zoom, Focus, Brightness and Preset Positions. It shall be able to search using: Time & Date, Event Type and Camera number.

E. The recorder shall have up to 8 recording programs including individual recording mode for each camera, and 6 time schedules per day.

F. The recorder shall have 2x built-in Gigabit network interfaces (10Base-T / 100Base-TX / 1000Base-T) for camera recording and client access.

G. The recorder shall have the capabilities to transfer recorded images to FTP server upon alarm and/or live image periodically. Images recorded in the SD memory card in the i-Pro network cameras can be transferred to the recorder automatically even when the recorder is in recording status.

H. The recorder shall be viewable from any properly connected PC using Microsoft Internet Explorer version 6.0 or later

I. The recorder shall provide user authentication and support different user privileges based on logon ID. From the client the user should (with proper authentication) be able to do the following:

- Setup cameras
- Define live viewing, recording rates and quality settings
- Define recording programs and schedules
- View live video in either single or quad views
- Search and playback recorded video
- Download selected recorded video
- Control connected PTZ cameras

J. Supported protocols: TCP/IP protocol, PPPoE, DHCP, DNS, DDNS, NTP, SADP, SMTP, SNMP, NFS, UPnP and iSCSI.

K. The power source shall be 120VAC, 60Hz at approx. 45W

PART 3 – EXECUTION

3.1 INSTALLATION

A. System installation shall be in full accordance with the Project Drawings, these Specifications, NFPA Standards, and the manufacturer's published recommendations. All junction boxes shall be painted yellow to indicate closed circuit television system wiring.

All equipment and products furnished shall be UL listed and labeled, and connection shall comply with construction standards.

B. Grounding shall be provided and connected in strict accordance with manufacturer's installation recommendations.

C. Protection, Cleaning, and Adjustment
   1. Protection from damage and contamination shall be provided for all system components, devices, and equipment during the entire installation and until acceptance testing.
   2. Damaged or contaminated devices and/or components shall be replaced before final testing.
   3. Final system adjustment shall be provided before final acceptance testing.

3.2 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting controls, focusing cameras, and sensitivities to suit actual occupied conditions. Provide up to three visits at eight hours a piece to the site for this purpose.

3.3 SYSTEM INITIALIZING AND PROGRAMMING

A. System shall be turned on and adjustment made to meet requirements of specifications and on-site conditions.

B. System shall be programmed to function as specified, and a copy shall be made of the initial program and made available to the owner. Coordinate programming with owner.

C. Any special programming shall be documented, and a written copy made available to the owner.

3.4 TRAINING

A. Contractor shall provide 4 hours of training to owner.

3.5 WARRANTY

A. The contractor shall provide a warranty on the physical installation of not less than one year at no cost to the owner. Information, with regard to the proper procedures to follow if needed should be included with the warranty. They should include but not be limited to; contact name, contact telephone number, project reference, anticipated response time.

END OF SECTION 282000

SECTION 283100 - FIRE ALARM SYSTEMS

PART 1 – GENERAL

1.1 SCOPE

A. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations in connection with the installation of the Fire Alarm System as shown on the drawings and as herein specified. Provide annunciation at entrance per FD requirements and central station contact shall be provided.

B. The complete installation is to conform to the applicable sections of NFPA-72, NFPA 101, Local Code Requirements and National Electrical Code with particular attention to Article 760.

C. Provide systems by Simplex, Honeywell, Notifier, Gamewell. Bosch, Siemens.

1.2 QUALITY ASSURANCE

A. 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 "U.L." label.

B. The equipment and installation supervision furnished under this specification is to be provided by a manufacturer who has been engaged in production of this type equipment for at least ten (10) years, and has a local, fully-equipped service organization.

C. All control equipment shall have transient protection devices to comply with UL864 requirements.

D. Provide a list of the manufacturer's NICET Certified representatives, (a minimum shall be NICET level III), for all persons who will provide future service, installation coordination, and/or final checkout of the system (including demonstration of proper operation to the (AHJ) authority having jurisdiction, the Architect/Engineer and owner's representative).

1.3 GENERAL

A. This system shall have Indicating Device Circuits (IDCs), configured as a hardwired, zoned system or an addressable system. An alarm from any zone shall cause all Audible Alarms (audible Notification Appliance Circuits, (NACs)), to sound throughout the building and shall remain in alarm until the audible NACs are silenced, and the Visual Alarms (visual Notification Appliance Circuits, (NACs)), shall flash until the control is completely reset. All auxiliary controlled circuits shall operate and shall remain in operation until the system is completely reset.

B. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans; to be wired, connected, and left in first class operating condition. The system shall use closed loop IDCs with individual circuit supervision, individual NAC supervision, incoming and standby power supervision. Provide all needed equipment to furnish a complete, fully functional system. Include a control panel, manual pull stations, automatic fire detectors, remote control devices, all wiring, conduit, terminations to devices, standard and special wall boxes, junction boxes and cabinets, labor, miscellaneous hardware and furnish all engineering services necessary to make a complete and functioning fire alarm system as hereinafter specified and shown on plans. Any equipment not specifically mentioned in this specification or not shown on the drawings but required for the operation of the system shall be furnished and installed.

1.4 SYSTEM DESCRIPTION

A. The system IDCs shall monitor automatic and manual initiating devices, operate all NACs, audio, visual, and cause all auxiliary control devices to operate on any alarm condition. The control panel shall be surface mounted where indicated, shall indicate individual zone(s) in alarm or a trouble condition. Fiber optic cable shall be used or communication between buildings and to clubhouse for interconnection.

B. To accommodate and facilitate job site changes, the control panel shall provide adequate space to individually configure on-site IDC, NAC, or auxiliary control circuit operation

C. NACs, audio and visual, shall be circuited as indicated and shall operate throughout the building during any alarm condition. Audio NACs shall sound a temporal code at a minimum of 15 dBA above ambient sound levels. Audio devices shall silence when the “Signal Silence” switch is operated. Visual NACs shall be Xenon flash tubes and shall flash at a synchronized rate. Flash intensity shall be a minimum of 75 Candela On-Axis, and shall meet UL 1971 and ADA requirements. Visual devices shall operate in the alarm condition after the audio devices are silenced, indicating there is still an active alarm present, and shall remain ON until the system is completely reset.

D. In any alarm condition ALL auxiliary control functions shall operate, shutting down air handling equipment, and the central station DACT, or direct line connection to the local fire department Gamewell systems and campus security. These auxiliary functions shall remain active until the entire system is reset. By-passing of these functions shall be possible, during servicing or testing procedures, through the activation of an auxiliary “By-Pass” switch. This action shall by electrically supervised, causing a “System Trouble” to occur, and this condition shall until the by-pass is restored to its “Normal” position.

1.5 SEQUENCE OF OPERATION

A. Activation of an alarm Initiating Device shall:
- Cause the display to display the zone or zones in alarm. An alarm log will be generated.
- Activate the panel tone-alert audible indicator;

- Cause the audible alarm NACs to sound in a Temporal Code pattern throughout the entire facility until silenced at the main or remote panels.
- Cause the common Auxiliary Alarm output to activate;
- Cause the IDC Auxiliary output DACT, or direct connection to activate;
- Cause the Visual NACs to operate until system is reset.
- Cause all Auxiliary functions to operate, stop air handling equipment, door holders release, elevator functions, etc.
- Contact an off-site, constantly supervised, approved authority.
- Main panels in each building shall send “trouble” signal to Clubhouse upon alarm condition.

B. Activating the Alarm Acknowledge shall cause:
   - The local panel audible tone-alert to silence;
   - Subsequent alarms shall resound the local panel tone-alert.

C. Activating the Alarm Silence switch shall:
   - Silence all NACs programmed for on-until-silence;
   - Shall illuminate the dedicated yellow alarm silenced LED.

D. Activating the Alarm Reset switch shall:
   - Restore the alarm initiating devices to normal;
   - Restore all alarm circuits to their normal condition.

E. Any Trouble Condition (a single open or a single ground condition), sequence of operation shall:
   - Activate an audible signal;
   - Flash a distinct indication at the yellow trouble LED display, and activate the common trouble output in accordance with the requirements of the applicable codes and standards so that all means of interconnecting equipment, devices, notification appliances and power supplies shall be monitored for the integrity of the interconnecting conductors, or equivalent.

F. Actuating the Trouble Silence switch shall silence the audible trouble signal.

G. Supervisory Condition Sequence of operation shall:
   - Be annunciated by flashing the dedicated yellow supervisory LED;
   - Activating the audible tone-alert;
   - Activating the common supervisory output.
   - Indicate the zone number of the IDC in supervisory condition by the red, seven segment fire alarm LED. This seven segment display shall clearly differentiate between alarm zone numbers and supervisory zone numbers.

H. Indicator Tests shall:
   - Provide an Indicator Test procedure for manually testing of the local audible tone device, zone alarm and supervisory display, zone trouble display, and individual operator panel LED indicators.

PART 2 - PRODUCTS

2.1 FIRE DETECTION AND CONTROL PANEL

A. The fire alarm control panel cabinet shall provide the following features:
   - The printed circuit board assemblies of the control panel shall be mounted such that removal of a common, single piece mounting chassis shall provide access for installing the cabinet and for pulling wires into the cabinet.

B. A label mounted to the inside of the cabinet door shall be clearly visible and contain information for the following:
   - Summarized installation instructions including location of standard, optional, and expansion modules;
   - Operating Instructions to include a readily available list to interpret LED display indications;
   - Summarized programming instructions;
   - A separate label shall be provided to allow on-site documentation of the specific location of the individual IDCs.

C. The Fire Alarm Control Panel shall contain:
   - Operator interface switches for status acknowledge, alarm silence, and system reset;
   - Discrete indicators to annunciate the following:
     - presence of AC power,
     - status of alarm silenced,
     - presence of supervisory conditions.

D. The control panel shall have a display that shall automatically scroll to chronologically display the IDC number of all alarm and supervisory conditions. Supervisory conditions shall be clearly differentiated from fire alarm conditions. This display shall be provided to annunciate the following:
   - The zone number of an IDC in Alarm;
   - Annunciate multiple IDCs in Alarm.
   - Indicate the number of an IDC in a supervisory condition.
   - Annunciate multiple IDCs in the supervisory condition.

E. The control panel shall have a display that shall automatically scroll to chronologically display distinct trouble conditions. Manual operation of the scrolling shall be provided to control the scroll rate. The following trouble conditions shall be capable of being displayed. This display shall display the following:
   - The number of an IDCs in trouble.
   - NAC 1 or NAC 2 trouble;
   - Annunciator interface module trouble;
   - Auxiliary alarm output trouble, indicated by zone;
   - Low battery;
   - Depleted battery;
   - Walk Test system test enabled;
   - Programming trouble;
   - Power supply trouble;
   - Ground fault trouble;

F. The power supply shall provide up to 4 amps of power to serve detectors, door holders, relays and all alarm notification appliances. In addition to the 4 amps of power for Notification Appliances and Auxiliary equipment, the panel shall provide adequate power to serve the maximum configuration of control panel modules. Provide surge protection on the power supply.

G. Include a secondary emergency power supply with capacity for operating system in standby mode for 60 hours followed by alarm mode for 5 minutes. The control panel shall obtain its primary operating power from a 120 VAC, 60 Hz supply.

H. A “Depleted Battery” warning shall be sounded in the event that operation on battery back-up exceeds the capacity requirements of the stand-by batteries. Operation shall include activation of the audible tone-alert and a unique indication shall be displayed on the operator control panel.

I. Active Status Reminder shall: When any Alarm, Supervisory, or Trouble condition be present within the system and the audible signal silenced, the local tone alert shall resound every 8 hours (each change of work shift) to act as a reminder that the fire alarm system is not 100% operational.

2.2 PERIPHERAL DEVICES

A. Provide Double Action Pull Stations (Manual Fire Alarm Boxes). They shall be manufactured from high impact red Lexan or aluminum, with raised and painted white lettering reading "FIRE, PULL HANDLE DOWN". The front of the station is to be hinged to a backplate assembly and will mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks. Pull stations will be double action and located as indicated on the prints. Mount on a standard 4" square flush back box, with single gang trim ring. These boxes and trim rings shall be furnished by this contractor.

B. Provide Alarm Horn/Strobe combination units as indicated. The horns shall be electronic, non-contact type, optical controlled diaphragm vibrating units, polarized and shall be operated by 24VDC. Each horn assembly shall include separate wire terminal for in/out wiring for each leg of the associated signal circuit. T-tapping of signal device conductors to signal circuit conductors shall NOT be accepted. The following type visual units (described in the next paragraph), shall be incorporated as part of the horn unit where indicated. The alarm horn/strobe units shall be suitable for mounting on a standard 4" square back box with a standard extension with trim ring. Finish shall be high impact, flame retardant PC/ABS thermoplastic red housings, having “FIRE” lettering on the face of each unit. Mounting, stand alone or with Xenon strobe units, shall be on a standard 4" square back box, with a minimum depth of 2 5/8" and a double gang trim ring. Standalone horns such as in apartment units shall be low frequency type. The 75 dB at the pillow shall be achieved by the system. This may mean adding devices not shown.

C. Visual indicating appliances (Xenon Strobes) shall be comprised of a Xenon flashtube, be entirely solid state and have shock-mounting arrangement to resist bulb failure due to vibration. These devices shall be UL listed and be capable of either ceiling or wall

mounting. The polycarbonate lens shall be pyramidal in shape, having a multi-surface reflector used to provide symmetrical light output in key axis directions, visible from a 180 field of view. The front panel or bezel which is constructed of UL Listed Noryl, may be inverted so that the lens, normally to the side of the audio device, can be mounted below the audible device. Visual units shall be of the stand alone type or be incorporated as part of the horn or speaker units. Units shall provide 4 wire connection to insure properly supervised in/out system connection. Visual indicating appliances shall flash with 110 Candela intensity in all shops and production areas, 30 Candela intensity offices and other finished areas. 30 Candela intensity shall be tested per UL 1971 for 75 Candela on-axis. Visual signaling devices shall provide intensity so that the viewer can discern when they have been illuminated, in ALL building areas when in alarm regardless of the viewer's orientation.

D. Provide photo electric smoke detectors, operating on light scatter principle, 24V DC two wire operation, complete with photo conductive cells, lamp (light emitting diode for light source) and self-compensating circuitry to provide maximum stability against effects of aging, dust and film accumulation. Detectors shall be factory set to detect smoke at a nominal 2.2% light obscuration per foot regardless of rate of combustion. Each detector shall be equipped with pilot light to indicate that the detector is in alarm condition and facilities for remote LED operation. For ease of installation and maintenance, detectors shall be designed for twist lock mounting on a separate base assembly, having screw terminals for external connections. Detector shall include a built-in micro fine screen (30 mesh - 900 hexagonal holes per square inch) to prevent entry of dust or insects. In addition, detectors shall incorporate "easy clean" chamber design which allows smoke chamber to be cleaned by simply removing twist-off smoke cover (smoke detectors that require major disassembly for cleaning not acceptable). Mount on 4" octagonal box.

E. Duct detector housings shall be shall be solid state, extrusion formed Lexan plastic construction, including mounting flanges and shall be capable of direct duct mounting. Duct housing couplings shall be slotted to insure proper alignment of the sampling and exhaust tubes. Sampling tubes shall be installed with the housing in place, and tubes shall be removable while the housing is in place, for servicing and testing operations. Housings shall have an alarm and power on LEDs, both visible through a the front cover of the housing. Photoelectric Detectors, mounted within these housings shall be as specified above, and these detectors shall also obtain their operating power from the supervised current in the fire alarm loop. Each housing shall incorporate a matching detector baffle, which, along with the correct length sampling and return tubes shall direct smoke through the detector. Installation must comply with NFPA-90A. Housings shall have remote LED outputs. Mount remote alarm test and indicator L.E.D.s as shown. These units shall be mounted on single gang box located on the ceiling below each Air Handling Unit.

F. Automatic heat detectors shall be fixed- temperature type. When the fixed-temperature portion is activated, the units shall be non-restorable and give visual evidence of such operation. Heat detectors shall be 200 degree F, fixed temperature.

G. Auxiliary relays shall be 24V DC operation, SPDT contacts rated at 10 Amperes each and shall contain an enclosure for mounting. Relays shall contain an LED indicator, which shall light when the unit is activated.

H. Door Holders shall be semi-flush type magnetic devices. Submittal shall have type used for each door.

2.3 FIRE ALARM WIRE AND CABLE

A. Fire alarm wiring for this system shall be per Section 16110, meeting these minimum requirements:
- All wire and cable shall be in strict compliance with local codes and the provisions of NEC Article 760 A and C for Power-limited Fire Protective Signaling Circuits;
- Shall be color coded throughout with the same color for same circuits from source to final termination;
- Shall be free from opens, grounds and shorts between conductors;
- All single strand wiring shall have a minimum isolation rating of 600 volts;
- Shall be in a completely separate conduit system;

PART 3 - EXECUTION

3.1 INSTALLATION

A. The control equipment shall be grounded with an approved ground wire.

B. Job Site Responsibilities:

- By Equipment Supplier:
- Technical installation support via On-job-site visits by sales and service staff, each being NICET certified, in the Field and sub field Number 00303, Fire Alarm Systems, with a Minimum, Level III certification;
- Power-up and complete system check out by our Technical Representative;
- Final letter of completion with detailed inspection report conforming to the NFPA 72 format and guidelines, signed by a NICET, Field and Subfield 00303, Fire Alarm Systems, level III certified person employed by the equipment supplier;
- Provide equipment operational training session(s), adequate to provide the customer proper operating information which will allow them to properly respond to Alarm and Trouble conditions without assistance from the equipment supplier. This training shall be video taped, with a first class copy provided to the customer for their future use in on-going training of employees;
- Provide all warranty repair of all equipment provided by manufacturer.

C. Electrical Contractors Responsibilities:
- Provide enough skilled supervision and labor to complete the project on schedule;
- Review and understand the submittal, drawings, and other instructions provided by the manufacture;
- Pull wire and mount panels and peripheral devices in accordance with specifications and code;
- Test all circuits for continuity with an OHM Meter, troubleshoot ground faults, shorts, and opens, and terminate all wires in peripheral devices and control panels using provided wiring diagrams;
- Follow procedures defined by Suppler to protect equipment from damage during construction or installation;

- Energize system only in presence of equipment supplier technical personnel;
- Provide as built wiring diagrams to the General Contractor the completion of the project.

D. Testing: The completed fire alarm system shall be fully tested in accordance with NFPA-72H by the contractor in the presence of the owner's representative and the Local Fire Marshal. Upon completion of a successful test, the contractor shall so certify in writing to the owner and general contractor.

E. Operating and Service Manuals

At the completion of the project, and at least 14 days in advance of request for final inspection, contractor shall provide two volumes of manuals containing the following:

- "Operating Instructions" for all items of equipment including start-up and shut-down procedures;
- "Service and Lubrication Instructions" for each unit of equipment, including spare parts list indicating local source of supply;
- Record shop drawings and catalog cuts marked to reflect "as-built" conditions;
- Each complete set of manuals shall be bound in a three-ring, loose-leaf, hard-back binder.

F. Warranty: The contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use.

END OF SECTION 283100

SECTION 284000 - ACCESS CONTROL SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to all Drawings and Specifications listed in Division 01 for additional requirements.

1.2 SUMMARY

A. The scope of work for this sub-contract shall include the installation and associated services for a fully operational IP base Access Control System as per manufacturer's guidelines, codes described within this document, that provide central security management, integrated control of the intended site.

B. IP base access control system shall be installed in the equipment rooms as indicated on the drawings, communicating to the over a local LAN connection. The system shall provide:

1. Provide all required power supplies.
2. Provide all cabling connections required.
3. Provide all specialty conduit requirements.

1.3 RELATED WORK

A. In addition to work described above, the Work shall include, but not necessarily be limited to, the following:

B. Equipment identification as indicated on drawings.

C. Providing all cabling, conduit and connections as required for complete and functional systems.

D. Providing 120 VAC uninterruptible power as required for all equipment provided under this contract.

E. Assemble equipment furnished disassembled in accordance with manufacturer's recommendations.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience, and with a certified servicing organization within 150 miles of Project.
B. Installer: Company specializing in installing the Products specified in this section with minimum five years documented experience. Experience shall include projects with surveillance systems of similar scope and magnitude. Company shall be a Certified by the product manufacturer.

1.4 MATERIALS AND EQUIPMENT SUBSTITUTION

A. Material and equipment installed under this contract shall be first class quality, new, unused and without damage. The intent of these specifications is to allow ample opportunity for Contractor to use ingenuity and ability to perform the work to his and Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.

B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.

C. In general, these specifications identify required materials and equipment by naming first the manufacturer whose product was used as the basis for the project design and specifications. The manufacturer's product, series, model, catalog and/or identification numbers shall set quality and capacity requirements for comparing the equivalency of other manufacturer's products. Where other manufacturer’s names are listed they are considered an approved manufacturer for the product specified, however; the listing of their names implies no prior approval of any product they may propose to furnish as equivalent to the first named product unless specific model or catalog numbers are listed in these specifications or in subsequent addenda. Where other than first named products are used for Contractor base bid proposal it shall be the responsibility of the Contractor to determine prior to bid time that the proposed materials and equipment selections are products of approved manufacturers which meet or exceed the specifications and are acceptable to the Engineer.

D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review and approval prior to procurement.

E. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.

F. Materials and equipment proposed for substitution shall be equal to or superior to that specified in construction efficiency, utility, aesthetic design, and color as determined by

Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access, forward two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.

G. Within 10 working days after bids are received, apparent low bidder shall submit to A/E for approval three copies of a list of all major items of equipment he intends to provide. As soon as practicable and within 3 working days after award of contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work for Architect/Engineer's review. Where 30 working day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certifications that order was placed within 30 working day limit.

1.5 DRAWINGS, OPERATION AND MAINTENANCE INSTRUCTIONS

A. Contractor shall furnish a minimum of two (2) sets of shop drawings of all materials and equipment. Architect/Engineer will retain one (1) set.

B. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, sizes, etc., that are to be provided. Mark each submitted item with applicable section and paragraph numbers of these specifications, or plan sheet number when item does not appear in specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each submittal shall contain at least two (2) sets of original catalog cuts. Each catalog sheet shall bear equipment manufacturer’s name, address and phone number. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

C. Contractor shall check all shop drawings to verify that they meet specifications and/or drawing requirements before forwarding submittals to the Architect/Engineer for their review.

D. All shop drawings submitted to Architect/Engineer shall bear Contractor's approval stamp which shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: telecommunications and electrical characteristics, provisions for supply, and drainage connections to building systems. All shop drawings not meeting contractor's approval shall be returned to supplier for re-submittal.

E. No shop drawing submittals will be considered for review by the Architect/Engineer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of contractor's review.

F. Architect/Engineer will not be responsible for or the cost of returning shop drawing submittals that are submitted to them without Contractor's review and approval stamp.

G. Architect/Engineer's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless such deviations have been specifically approved in writing by Owner or the representative, nor shall it relieve Contractor of responsibility for error in shop drawings. No work shall be fabricated until A/E's review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be Contractor's responsibility.

H. Submit with shop drawings of equipment, two (2) sets of operating and maintenance instructions and parts lists for all items of equipment provided. Instructions shall be prepared by equipment manufacturer.

I. Keep in safe place, keys and wrenches furnished with equipment under this contract. Present to Owner and obtain receipt for same upon completion of project.

J. Prepare a complete brochure, covering systems and equipment provided and installed under his contract. Submit brochures to Architect/Engineer for review before delivery to Owner. Contractor at his option may prepare this brochure or retain an individual to prepare it for him. Include cost of this service in bid. Brochures shall contain following:

1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined under Section this specification.
2. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
3. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of system.

K. Provide brochure bound in black vinyl three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:

1. Project name and address.
2. Section of work covered by brochure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

The Security Management System (SMS) shall be the Kantech EntraPass Corporate Edition. Or approved equal.

2.2 DESCRIPTION

The Security Management System (SMS) shall be an integrated system that utilizes a Sybase embedded SQL database for the storage and manipulation of related data. The SMS shall include a server with applications software, multi-site gateways for communication between the server and controllers, operator and administrator workstations with appropriate software, hard copy printers and secure backup media. The security field devices (readers, door position switches, REX, etc.) shall communicate with the field panels

via a dedicated cable network. The field panels shall communicate to the server via a Fast Ethernet 10/100, TCP/IP network, RS 232/RS 485 connection, or dial-up modem.

The SMS shall allow for growth and scalability from a smaller system to a larger, high-end, or enterprise system. The SMS shall be modular in nature, allowing system capacities to be easily expanded without requiring major changes to system operation. All defined system data as well as historical information shall be maintained. Customizable user interfaces shall allow management of system information and activity for administrators and operators. The response time between the moment when a card is presented at the reader and when the door is unlocked shall not exceed one second. The SMS shall include a badging solution with a GUI for badge design. No extra licensing shall be required for the badging solution.

The SMS shall be able to connect to authenticated non-SSL or non-authenticated email server for all email features described. The SMS shall be able to connect to SMTP or POP3 authenticated email server.

The SMS shall support up to:

20	Workstations
4	Concurrent WebStations
20	Redundant servers
Unlimited	Digital video recorders
41	Multi-site gateways
17,408	Door controllers per Multi-site gateway
69,632	Card readers and/or keypads and/or elevator cabs of 64 floors each per Multi-site gateway
Unlimited	Access cards
Unlimited	Card families or site codes
4,456,448	Monitored points per Multi-site gateway
4,456,448	Control relays per Multi-site gateway
2	Simultaneous user languages

2.3 PERFORMANCE - MONITORING

A. Monitoring Mode

1. The SMS shall enable every operator to customize his/her desktop configuration. It shall be possible to modify the desktop appearance and to create up to eight desktops and to associate up to ten different display screens to each. It shall be possible to modify the size and position of all screens. It shall be possible to determine if these screens shall be floating anywhere on the desktop or fixed on the desktop. If the workstation is equipped with a dual output video card and two or more monitors, it shall be possible to distribute the screen to multiple monitors. However, each screen shall be able to be viewed alone or together depending on operator needs. Once these parameters are saved, the configuration shall automatically take effect whenever the operator logs in. For all types of screens, it shall be possible to access the general properties of the screen by simply right clicking at the center of the screen. From there it shall allow for linkage between associated screens without having to exit the current screen or section.

It shall be possible to right click events on the desktop for editing which shall bring the user directly to the card, door, or component window and back.

2. Message Screen

   All events that occur shall appear in real time. The text shall include at least the date, time, and a pertinent description of the event as well as its condition. The display of this screen shall be customizable and a different background and message color can be used for every type of event.

   All component modification events shall be tagged with addition (+), modification (=) or deletion (-) tag.

   Every in-coming event shall be documented by one or more icons representing video images, photos, access card, server, gateway, controller, card reader, and relay or supervision point. It shall be possible to classify the events on the screen by sequence, date and time, type of event, or type of message. In addition, a text filter shall be available to facilitate searching. It shall be possible to access the last up to 100,000 transactions from this window without the need to request a special report.
   It shall be possible to right click on an event and perform edit or other functions linked to the event.

3. Card Holder Photo Screen

   When a card is presented to a card reader, the software shall automatically display the photograph of the cardholder in this window. From this screen it shall be possible to select the cardholder's name, card number, event text, and comments as well as specify a door or group of doors for which the operator would like to display a photo. The SMS shall support the display of up to 4 pictures simultaneously. Furthermore the SMS shall allow that each picture box be assigned to a specific door for additional filtering
4. Filtered Message Screen

   This screen shall be a copy of the text messages screen except it shall be possible to select a specific message filter. The SMS shall include a choice of pre-configured filters and the ability to create customized filters. For every new filter it shall be possible to associate a name to it, select the type of event, select door, select workstation, select gateway, select supervision input, and select output.

5. Alarm Screen

   Alarms that require an acknowledgement by an operator shall be displayed on this screen in text form only. The text shall include at least the date, time and description of the alarm, and its condition. It shall be possible to classify events on the screen by sequence, date and time, type of event, or type of message. A text filter shall be available in order to facilitate the search.

   If instructions about an alarm are envisaged, they shall automatically appear in a second window on the screen. If a graphic is associated with the alarm, it shall appear

automatically on the screen defined to this effect. The icon associated to the control point shall be represented and show the actual state of the point.

The operator shall be able to access a log book in order to document the alarm that occurred. Once this information is recorded in the log it shall not be erasable or modifiable. Operators shall also be able to see previous comments or system logs added this event.

Operators shall be able to run a report of the alarms from this window.

It shall be possible to associate video call-up with an alarm. When this occurs, the main screen shall become the video screen, not the alarm screen.

6. Video Screen (Video View)

When the SMS is integrated with American Dynamics digital video recorders, it shall be possible to view the video images of cameras associated with them. The SMS shall enable the creation of an unlimited number of video views, each one associated with up to 16 different cameras or graphics. . It shall be possible for the operator to see at a minimum 48 cameras simultaneously using three video views per screen. It shall be possible for an operator to edit or modify an existing view or create a new one directly from this screen. For each video view it shall be possible to select sequential, mosaic pattern, or preset viewing modes.

It shall be possible for an operator to access all the commands of a motion PTZ camera to include rotate on its axis, adjust its focus, and have a larger view of the image. Accessibility to camera images and commands shall be limited by operator security level.

No additional licensing shall be required to perform this function.

7. Historical Message Screen

This screen shall allow operators to choose from a previously created custom report. Operators shall choose a start/end date/time. The report will be populated in this window and have the same characteristics of the message screen including all right click functions.

The historical message screen shall allow operators to add comments to any event this can be later seen and reviewed.

B. Graphics Screen

1. There are three options for graphics that appear as background on the screen. The first is a reproduction of the building(s) floor by floor. The graphic module shall be capable of importing files in BMP, EMF, WMF, JPEG, GIF, PCX, PNG, TIF, or PCD formats.
2. The second option is using web pages, or WebViews, as background on the screen. This can be used in the following manners:
   a. Accessing to DVR web servers

b. Embedding default web pages into operator desktops
c. Adding an IP camera onto a video view
d. Embedding intranet pages or directories into the operator environment
e. Adding PDF, Word documents, etc. to the desktop
f. Accessing to network cameras from the WebStation
g. HTML or PDF pop-up instruction on alarm
h. Integrating report folders in the desktop for quick access

3. The third option is to assign a live video view as background on the screen if video integration is being utilized.
4. For all three options, control points shall be represented by a descriptive icon. Control points include workstations, gateways, controllers, card readers, doors equipped with either card readers or supervision contacts, cameras, relays, and input monitoring points such as motion sensors. The icons shall be animated, meaning they shall represent the state of the point to which they are associated in real time. Every graphic shall support at least 100 control points.

   Right clicking on an icon shall directly access the manual commands of each control point. A door shall be capable of but not limited to temporarily unlocking, manually unlocking or locking, and enabling or disabling a reader. A supervision point shall be capable of being enabled or disabled. A control relay shall be capable of being activated, deactivated, or temporarily activated. Cameras shall be capable of viewing images or live video.

   No additional licensing shall be required to perform this function.

C. Communication Methods

1. The SMS shall ensure the communication to remote sites over a LAN or WAN/Internet using a dedicated communication server device, Kantech IP Link or the KT-400 controller. This shall only be applicable with the use of Multi-site Gateways. It shall ensure secure communications by the use of 128-bit AES Encryption. It shall reduce bandwidth consumption by managing the communication protocol of Kantech controllers at the remote site. Polling of Kantech controllers shall be done by the Kantech IP Link or KT-400 in the field and not over the network. The Kantech IP Link or KT-400 shall provide support for up to 32 door controllers. The Kantech IP Link or KT-400 shall be configured from the access software or from a web page which has the security feature of being disabled after successful use.
2. For sites that do not have network links, communication to remote sites shall be ensured by Dial-up modems. This shall only be applicable with the use of Multi-site Gateways. The SMS shall support up to 32 such modems that can simultaneously communicate and transmit or receive data from remote sites. No modem shall be dedicated to specific sites; communication shall be established such that the first site calling shall have access to the first available modem, and so on.
3. Each Multi-site Gateway should be able to control 32 local controller loops by using the RS-232/RS-485 protocols via serial or USB port. In addition, each Multi-site Gateway should be able to control up to 512 Ethernet loops using TCP or UDP protocols, via the use of the Kantech IP Link, or KT-400 of 32 controllers each.

4. In all communication methods, the door controller shall retain in their memory all necessary data for controlling doors that they supervise. In case of communication failure, the door controller shall execute all its functions normally.

2.4 PERFORMANCE – PROGRAMMING & CONFIGURATION

A. User Section

1. This section shall include all functions involved in the issuance of an access or ID card as well as database search and importation tools. During the addition or modification of a card, information about the card shall be sent to the door controllers affected by these new parameters as soon as the operator accepts the addition or modification. An additional command requiring a reloading of the cards database in the door controllers shall not be acceptable.
2. The SMS shall enable the creation and definition of a user access card. There can be up to five cards per user and users can be managed by cardholder name or card number. When creating user cards, the operator shall be able to select a card format directly from a Card dialog and enter the card number as it is printed on the card.
3. The following user information shall be able to be saved in the user section:
   a. 5 Card numbers each with their own expiration date, trace and lost or stolen statuses.
   b. First and last name
   c. Card type
   d. Additional information (10 fields)
   e. Start date
   f. Expiry date
   g. Personal ID number (PIN)
   h. State of the card
   i. Multi-swipe activation
   j. Comments

   In addition, it shall be possible to associate a photograph, signature, and badge template to a card. The picture of the card holder shall always be visible when the profile is active on the screen.

4. The SMS shall allow for the creation of an unlimited number of card templates to be used as ID cards. Template parameters include name, number of sides, and size. It shall be possible to directly print a template on an access card. The operator shall be able to design customized badging templates directly from the access management software. No specific badging program or software other than the latter and no additional licensing shall be required for this function. Any workstation shall be capable of creating ID cards based on operator security level. The following items shall be capable of being added to and modified on a badge template:
   a. All information fields associated to a cardholder
   b. Bar code
   c. Text zone
   d. Start date, expiry date, today’s date

e. Saved images and logos
f. Borders
g. Rectangles (including rounded rectangles, ellipse)
h. Lines and arrows
i. Photograph (can be cropped)
j. A background

5. The SMS shall allow for the creation of a day pass to be issued to visitors for a single day. The SMS shall also have the ability to create temporary ID visitor cards.
   The SMS shall offer the possibility of modifying the parameters of a group of cards simultaneously based on Card Type. The system shall enable the creation of an unlimited number of card types. The following fields shall be modifiable:
   a. Card status (valid, invalid, lost, stolen)
   b. Card monitored (yes, no)
   c. Start date (schedule)
   d. End date (schedule)
   e. Delete after expiration (yes, no)
   f. Wait on keypad (yes, no)
   g. Access group (selection menu)
   h. Template model (selection menu)
6. The operator shall be able to search for a card by last or first name, card creation date, card number, or any of the ten fields of user definable information. The system shall display the last card transactions, namely the latest sixteen denied access events, authorized events, database events, and/or time & attendance events.
7. The operator shall be able to quickly view the cardholder's door list
   a. Operators shall be able to export the door access list.
   b. A detailed view of the door's schedule shall be show when selecting a door.
8. The operator shall have the option of expanding the comments field in the user section for better viewing.
9. The SMS shall enable the creation of an unlimited number of Import/Export models, give them a name, select required fields, select their layout, and determine the filed delimiter. This shall allow for acceleration of the data entry process by importing databases from a spreadsheet.
10. The SMS shall allow for 250 access levels programmed per loop/site of controllers. Every card shall be assigned an access level which shall determine where and when the access card will be valid. When the system consists of several sites or gateways, it shall be possible to use batch programming of access levels.
11. The SMS shall allow for creation of tenant lists that can be imported in the (Kantech Telephone Entry System) KTES units. The lists shall be easy to fill up and allow for up to 3000 tenants in each list. The SMS shall support the creation of unlimited amounts of tenant lists.
12. The SMS shall allow of importing and exporting of tenant lists. The operator shall have the ability to choose which fields to import and export.
13. The following tenant information shall be able to be saved for each tenant.
    a. Tenant name
    b. Tenant ID (customizable in length per tenant list)
    c. Primary Telephone Number
    d. Secondary Telephone number
    e. Tenant PIN (customizable in length per tenant list)

f. Pin access schedule
g. Tenant level
h. Tenant language
i. Card number
j. Disable card trace
k. Start/End date
l. No disturb schedule
m. Prioritized tenant in the display list
n. Call second phone number option schedule
    i. Ability to call the second phone number only (does not call primary) during valid schedule

14. The SMS shall allow for a card number to be assigned to specific tenant. The KTES unit will be able to send the card number to other controllers of a Wiegand protocol.
15. The SMS shall allow for an unlimited amount of Card Types. Cards types shall be used to group cards together for ease of management. Card types shall have the option of being assigned a card access group template. Card access groups shall be copied to the card holder profile to give the card holder's access levels.
16. The SMS shall provide the possibility to perform card batch operations. The mass card modifications shall take effect in real time. Each batch operation shall allow for mass cards to be changed based on their card type. The batch card modification shall be able to change:
    a. Card State
    b. Supervisor level
    c. Card count value
    d. Card Tracing
    e. Start Date
    f. End Date
    g. With deletion on expiration
    h. Waiting for keypad
    i. Card access group
    j. Replacing access levels
    k. Updating access levels
    l. Adding new access levels
    m. Updating and adding new access levels
    n. Card Badge layout

B. Video Section

1. The SMS shall be capable of being combined with up to 300 American Dynamics Intellex digital video recorders and American Dynamics Hybrid DVR (HDVR), American Dynamics TVR2 and American Dynamics Video Edge NVR v4.00. From any of the workstations it shall be possible to do the following:

    a. View one or more camera images from different sources
    b. Query the history of each recorder and view images saved on disk
    c. View, modify, or delete programming parameters of a recorder
    d. Control the movement of all motion cameras directly with the workstation mouse of the SMS (PTZ control)

e. Export camera images to hard disk and video vault (capable of exporting multiple formats, password protected to protect chain of evidence)

2. The SMS shall ensure the time management and synchronization for all digital video recorders. It shall be possible to determine the time refresh frequency on the network. The SMS shall allow for configuration of each digital video recorder. For each recorder it shall be possible to:

   a. Assign a name
   b. Determine the recorder type
   c. Determine the network IP address or domain name (DNS)
   d. Manually configure the video, communication and event ports
   e. Determine the number of cameras
   f. Determine the query frequency
   g. Determine the number of failed queries required before a loss of communication message is displayed on the screen
   h. Import camera details from existing video servers

3. The SMS shall define the programming parameters for every camera connected to a digital video recorder. For each camera it shall be possible to:

   a. Assign a name
   b. Determine the type of camera
   c. Assign a representative icon for identification on a graphic screen
   d. Determine if the camera image can be visible on a video view
   e. Determine the type of recording
   f. Determine which events from the recorder should display an alarm message on the screen
   g. Determine the number of pre-selections desired
   h. Determine the number of patterns desired
   i. Add comments to record in the video vault

4. The SMS shall allow for the creation of an unlimited number of video views. For each video view it shall be possible to connect up to 16 cameras from various sources.

5. The SMS shall be able to incorporate on the same view multiple cameras from different American Dynamics Intellex DVRs or graphics. Furthermore on different video views the SMS shall be able to incorporate multiple cameras source from different American Dynamics HDVR or graphics. In addition on different video views the SMS shall be able to incorporate multiple cameras source from different American Dynamics TVR2 or graphics. In addition on different video views the SMS shall be able to incorporate multiple cameras source from different American Dynamics Video Edge NVR or graphics

6. The video view programming parameters make it possible to:

   a. Assign a name
   b. Determine the view size

c. Determine the refresh rate of the image
d. Determine whether to show metrics
e. Determine whether to show camera controls
f. Determine whether to show overlays
g. Determine whether to auto-hide text
h. Determine whether to activate image zoom
i. Determine whether to activate video sequence
j. Determine delay before sequence launch
k. Determine camera display delay
l. Determine display pre-selection delay
m. Determine pattern display delay
n. Determine graphic display delay
o. Determine display mode (1x1, 2x2, 3x3 and 4x4).
p. Incorporate up to 16 cameras from various sources or 16 graphics

7. The SMS shall be able to trigger, from one or more specific events, the start of a recording on a recorder with one or more cameras connected to it. The SMS shall allow for the creation of an unlimited number of video triggers. The SMS shall allow for the creation of an unlimited number of recording parameters. For each recording parameter it shall be possible to:

    a. Define a name
    b. Select the digital video recorder to which this recording parameter refers
    c. Select the camera to which this recording parameter refers
    d. Associate a pre-selection or size
    e. Determine the start recording trigger
    f. Determine the pre-alarm time
    g. Determine the total recording time
    h. Determine the stop recording trigger

8. It shall be possible for a video event on one digital video recorder to trigger an action on another digital video recorder.

9. The SMS shall allow the playback of all recordings stored on the hard drive of any of the digital video recorders. The operator shall be able to save the video into the video vault.

10. The SMS shall provide the operator access to the complete list of normal and abnormal events that required the activation of video recording. The sequence of images can be saved to a hard drive for subsequent consultation and shall be encrypted. The SMS shall allow the operator to access a complete list of alarm recordings in progress including origin of the alarm. The SMS shall be capable of displaying a list of exported videos.

11. It shall be possible to view recorded video tagged to an Access or Video event by quick linking from the Message desktop.

12. The SMS shall be capable of connecting 128 American Dynamics DVR/NVR with no additional options needed.

13. The SMS shall allow increasing the number of American Dynamic DVR/NVR in groups of 128 by the use of option codes. The SMS shall support unlimited connections.
14. The SMS shall allow for installation of remote modular video managers. The remote video managers shall be available only after the first 128 connections have been reached,

C. Definition Section

1. The SMS shall allow the creation of 100 schedules per loop/site of controllers and an unlimited number of system schedules. Each schedule can include up to 4 intervals. A schedule can be associated with a supervision point, a relay, an access level, a door, elevator floor, an operator, or an event. The SMS shall allow time zone management.
2. With a Multi-Site Gateway, specific schedules which include up to 20 intervals shall be available for the KT-400. The KT-400 shall keep all 20 intervals in memory when in standalone mode.
3. The SMS shall allow the creation of 366 holidays. It shall be possible to define a name, define a date, and determine the type. The SMS shall allow the operator to view all the holidays defined in holiday type and sites by viewing them all in a yearly calendar.
4. The SMS graphics shall enable operators to view the exact location of a component installed at the site, or the state of components and peripherals represented in the graphic such as doors, contacts, motion sensors, controllers, and cameras. The SMS shall allow for the creation of an unlimited number of graphics. The components on the graphics represented by icons as well as the graphics themselves shall have the ability to be modified. The SMS shall allow for printing of the graphics with their respective components on the graphical floor plan.
5. The SMS shall allow the management of 2,048 elevator cabs of 64 floors each for each gateway. It shall be possible to associate a schedule to the call button. Outside of the schedule, a valid card for a particular floor will have to be presented to the cab reader for it to be activated. The floor selection button group associated with the card's access level will become operational for a predefined duration and all other buttons shall become inactive. The SMS shall allow the creation of groups of floors and access levels.
6. The SMS shall provide the possibility to setup unlimited amount of tasks via the user friendly task builder. The operator shall be able to create emails templates that can incorporate variable to dynamically populate the emails. Using the command GUI menu, the operator can program commands for any component in the SMS. Commands such as but not limited to lock, unlock, temporary unlock, toggle, back to schedule for the doors, relays, inputs and enable and disable readers. The operator can also program commands for specific card count. The commands should be able to accept specific components or variables that can filled dynamically.
7. The SMS shall provide the possibility to setup unlimited batch card operations via the user friendly task builder. The mass card modifications shall take effect in real time. Each mass card modifications task shall allow for mass cards to be changed based on their card type. The mass card modification task shall be able to change:
    a. Card State
    b. Supervisor level
    c. Card count value
    d. Card Tracing
    e. Start Date

f. End Date
   i. With deletion on expiration
g. Waiting for keypad
h. Card access group
   i. Replacing access levels
   ii. Updating access levels
   iii. Adding new access levels
   iv. Updating and adding new access levels
i. Card Badge layout

8. The SMS shall provide the possibility to assign the tasks previously created to be triggered on specific components and specific events.
9. The SmartLink Task Commander shall process the command from the first available SmartLink application on the SMS.
   a. The use of a specific SmartLink to run the SmartLink Task Commander shall not be accepted. The SMS shall accept many SmartLinks to be installed thus providing a redundant SmartLink for all SmartLink Task Commander tasks.

D. Devices Section

1. The physical components of the SMS including workstations, Multi-site gateways, gateway, site, controllers, Kantech Telephone Entry System (KTES), doors, relays, and monitored inputs shall be individually configured and defined. Individual sites shall also be defined. The software shall allow the use of a controller Express Setup feature in order to minimize the time needed for controller definition.
2. Each component in the Devices Section shall allow for a comment section per component. The SMS shall allow for unlimited amount of characters in the comment section.

E. Alarm Interface

1. The SMS shall interface with any external alarm system thereby arming or disarming the system by presenting a valid card to an entry / exit door. It also shall be possible to associate a keypad with a reader forcing the cardholder to enter a number in the keypad after presenting a card. This integration shall only be possible with the use of a Multi-ste gateway. It shall be possible at a minimum to:
   Set a monitored input as an arming button
   a. Associate a usage schedule with an arming button
   b. Set the exit and entry delay
   c. Determine whether the system must wait for a valid access to arm
   d. Determine whether the system must wait for a valid access card swipe and appropriate pin number to disarm. Determine whether the door must relock on arming request
   e. Associate a monitored input with an alarm panel condition
   f. Lock a door unlocked by a schedule when armed

F. Intrusion Integration

1. The SMS shall allow interface with the DSC PowerSeries PC1616, PC1832, PC1864 and MaxSys 4020 series alarm panels intrusion panel thereby eliminating hardwired

integration between the SMS controllers and the DSC PowerSeries® intrusion panel. The DSC PowerSeries® intrusion panel shall communicate with the Multi-site gateway via rs-232 or directly to a KT-400 controller. The SMS shall allow for:

a. Single / multiple partition arming and disarming via reader
   i. Disarm via card only or forced valid card and pin
b. Single / multiple partition arming and disarming via operator commands
c. Receive events from intrusion panel
d. Receive partition names, user codes and zone names programming.
e. Update user codes
f. Assign user codes to cardholders
g. Viewing a fully functional virtual keypad to perform all functions available on the DSC PowerSeries® or the MaxSys 4020 intrusion panel keypad
h. With the MaxSys 4020 integration the SMS shall be able to control the PGM outputs from a graphic screen

G. System Section

1. The SMS shall define the profile of a system operator based on name, password, language, privileges, login schedule, security level, workspaces, and password expiry date. The SMS shall provide the possibility to force the operators to assign a mandatory card type to the users. The operator shall be able to provide a default card type for every card.
2. The SMS shall determine access rights granted to an operator based on security levels. There shall be three predefined access levels called Installer, Administrator, and Guard. The SMS shall have the ability to create an unlimited number of security levels that can be assigned to one or more operators. It shall be possible to determine from which system components the operator shall be authorized to receive events and take action. It shall be possible to specify for each programming window if the operator can (any combination):
   a. View the component in read only
   b. Add new components
   c. Modify existing components (cannot add new)
   d. Delete components
   e. Save as
   f. Print components
   g. View links
3. The SMS shall allow System Administrators to grant or deny operators access to all system physical components such as gateways, sites, controllers, doors, relays, inputs, access levels, reports, schedules, tenant lists, video servers, card types, etc. using Workspaces. This allows greater ease for larger sites to locate and assign components that pertain to specific gateways and sites. System administrators shall be able to tailor specific system applications and workstations Workspaces, therefore restricting access to information to all levels of operators. Operators shall be able to use temporary workspaces to narrow their fields of view when accomplishing specific tasks, and then easily revert back to their main workspace.
4. The SMS shall allow for the creation of unlimited instructions. These instructions shall be attributed to one or more events that will be used in documenting the event and

guide the operator on duty in performing tasks. It shall be possible to edit the instructions in two different languages.

5. The SMS shall make it possible to customize system events. All events shall be pre-defined to display on all system workstations. For each event it shall be possible to:
    a. Determine a display schedule
    b. Determine a color
    c. Assign a printer
    d. Associate one or more workstations
    e. Associate an instruction
    f. Associate a schedule for an acknowledgement request
    g. Determine the priority level

H. Report Section

1. The SMS shall include templates for various types of reports to include the following:
    a. Card use reports
    b. Manual operations reports
    c. Alarm reports
    d. Historical reports
    e. Time & Attendance reports
    f. Detailed reports
    g. Summary reports
    h. Statistical reports
    i. Roll Call Reports
2. The SMS shall allow for the creation of custom reports based on any event or component in the system. The SMS shall support an unlimited amount of customized reports.
3. All reports shall be able to be displayed on screen, printed, or sent by e-mail on a daily, weekly, or monthly basis. All event reports can be automated to be generated and sent at a specific time for a specific time period.
4. The SMS shall support at a minimum the following report formats: Sybase, Dbase IV, CSV, XLS, PDF, RTF, and TXT.
5. The SMS shall be able to generate an access report in CSV with all the card information associated to that access event.
6. All component modification events shall be tagged with addition (+), modification (=) or deletion (-) tag. In all event driven reports the operator shall have the choice to specify a tag or all tags in order to further filter report.
7. The system shall support for the creation of custom Time and Attendance reports. Each time and attendance report shall support up to 32 rules for masking the entry and exit times of each card. Also each report shall support a “First entry and last exit” feature.
8. Time and attendance reports shall have the possibility to compile the report in using fractions base (percentage) or actual hours and minute base.
9. The SMS shall allow the creation of custom Roll Call reports, which can without operator intervention be emailed to multiple people and/or printed on multiple printers. The Roll Call report shall be a system wide feature.
10. Each report quick report, historical report and time attendance report shall have a priority number assigned to it. When multiple reports are requested. The SMS shall prioritize the creation of the report based on their priority number. From the Report

queue management window the operator shall have the possibility to promote the report to a higher priority. The operator shall also have the ability to request more processing power form the computer in order to expedite the report creation.

11. Reports shall be prioritized from queue of 1 to 99. When the report is requested as priority 1 it shall be processed first. The default value for all new reports shall be set to 50. Operators shall be able to change it as needed.

I. Help Section

1. The SMS shall have contextual help button every window. The operators shall also have option of pressing F1 on their keyboard and Help window will appear with the correct section of the item they were looking at in the SMS
2. The SMS shall include an About window which shall include basic information about the SMS. It shall also include the KAP start/end date and tokens needed. The operator shall be able to send KAP details via email to a pre-defined email list by the click of one button.
3. In addition the About Window shall include contact information for the SMS manufacturer and contact information for the installation company/dealer. The dealer information shall at a minimum but not limited to:
   a. Company name
   b. Address
   c. Website link
   d. Email link

J. Options Section

1. The SMS shall allow operators to access basic server and display functions and allow the operator to determine default settings for the server hard drive. The operator shall also be able to determine the time to perform a server backup, programmable on monthly, weekly, or daily basis. It shall be possible to schedule and plan mass automatic KT-400 firmware updates.
2. The SMS shall allow for the servicing company to enter their contact information for the SMS operator’s disposal.

K. System Status Section

1. The SMS shall allow operators to view the state of various access system components in text or numerical form. A specific controller’s state shall also be able to be viewed in graphic form via the picture of the controller with the status of each terminal. Workstation and database status shall also be able to be displayed.

L. Various Tools

1. The SMS shall employ an Express Setup to configure system components such as sites and controllers, as well as peripherals associated to these components such as ports and inputs. This utility will reduce the programming time to a minimum.
2. The SMS shall employ a database utility to allow the re-indexation and verification of archived files and verify the integrity of indexes, links, and database arborescence.

3. The KT-Finder tool shall help troubleshoot the Kantech IP Link and KT-400 on site or remotely. It can also be used as an alternate method of configuration for both.
4. The SMS shall include a vocabulary editor to be used in designing custom language dictionaries.

M. Video Vault

1. Video Vault is an optional remote networked application used to automate recovery of video data from the digital video recorders and save it on a disk for long term video storage and retrieval. The information can be stored on an independent system or within the server. The footage that shall be tagged and recoverable from the digital video recorders shall include SMS triggers, manual triggers, and saved video server footage.

2. For the archived video files it shall be possible to:
   a. Assign a folder name to index the archived files
   b. Create sub folders based on day of the week, day, week, month of the year, month, video server name, camera name and/or event description name.
   c. Determine the hard drive to store the recovered videos
   d. Determine the composition of the name of the saved file
   e. Determine the format of the saved video
   f. Assign a frame from the saved video to represent as a saved file
   g. Determine the number of simultaneous downloads
   h. Determine a size limit for recoverable videos
   i. Assign a password to videos stored
   j. Determine a delay between requests to the server
3. There shall be scheduled transfers for archiving thereby reducing video network traffic during peak times.

2.5 PERFORMANCE – WEBSTATION

A. WebStation

1. WebStation is an optional tool that will allow for performing certain functions from a remote location to be used with the regular SMS system via Web Browser. The WebStation provides card management to guards, secretaries, or managers without the need to deploy a full workstation. A concurrent connection option shall provide access to a pre-determined number of users.
2. The WebStation shall have the ability to be viewed in multiple languages. Each WebStation shall come in English and French. Customer languages can be created using an easy to use tool. The WebStation shall automatically detect the Web Browser's preferred language.
3. The Webstation shall at a minimum be supported by Internet Explorer 6-7-8, Mozilla Firefox 3.6, Google Chrome 6.0 and Safari 5.0.
4. The following functions are available using WebStation:
   a. Card management (including 5 cards per username)
   b. Live card holder picture capture using camera
   c. Live signature capture using signature pad
   d. Viewing the card's last transactions

e. Exporting in CSV format the card list with all the card information
   i. Search for specific cards to export
f. Forgot Password & Reset password
g. Create, modify and delete access levels
h. Create, modify and delete schedules
i. Assigning access levels
j. Performing door operation
k. Performing relay operation
l. Performing input operation
m. Performing elevator operations
n. Requesting historical reports via email
o. Viewing live events using menu or quick launch viewer
   i. Export events in CSV or Excel XML format
   ii. Customize the view of the events to have the newest event on top
   iii. Filter events using message filters
   iv. Search for events using text filters
p. Using WebViews

2.6 INTEGRATION

A. SmartLink

1. The SmartLink application offers the ability to send messages to pagers and cell phones and through the use of e-mail. SmartLink provided instant e-mail notification of alarm events and the ability to e-mail reports.
2. Integration with other systems can also be done through the SmartLink API. This tool is used for advanced integration with third party applications like visitor management software, human resources systems, time and attendance systems, video systems, HVAC, etc.

B. Card Gateway

1. The Card Gateway is an optional external interface that shall allow the client to make modifications to the system card database through an Oracle or MS-SQL database. The application may be installed and run on the server's CPU. It shall allow for HR software integration and enable operators to modify, add, or obtain information on cards in real time.

2.7 REDUNDANCY & MIRRORING

A. Redundant Server

1. The SMS shall be able to support an optional redundant server whose main function shall be to monitor the primary server and ensure automatic (Hot Standby) take over if necessary. The redundant server shall have all the same characteristics and functions as the primary server.

2. The transition between these servers shall be completely transparent. When the primary server is operational once more, it shall be capable of synchronizing its database automatically with the redundant server and then resume absolute control of the access management system. No human intervention shall be required in this operation.
3. The operator shall be able to perform any and all operations during a fail-over synchronization between the primary server and redundant server.
4. The system shall support the use of multiple simultaneous redundant servers. The need to install third party (not EntraPass) licensing shall not be acceptable.

2.8 OPERATION

The SMS shall perform the following tasks:

1. Allow card access management for one or more buildings.
2. Control access to various doors equipped with a card reader. Allow the ability to set card use count options to limit the number of times a card can be used.
3. Allow automatic transfer of cards to an unknown area by a push of a button for emergency exit purposes.
4. Monitor all defined alarm points as well as all doors controlled by card readers based on programmed schedules.
5. Send transactions for which printing is required to one or more printers, based on a set schedule.
6. Access the system using the main and secondary menus (to which access is limited by a password) to make additions and required changes to various data files so that they can be updated by the user without the manufacturer's assistance.
7. Enable the entry of access code data for every card or group of cards.
8. Seamlessly connect to onsite alarm systems.
9. Fully functional virtual keypad with DSC® PowerSeries PC1616, PC1832 and PC1864 alarm system in addition with the DSC MaxSys 4020 alarm panel. The operator shall perform all functions available on a standard keypad with the PowerSeries or MaxSys 4020 series alarm systems. The operator shall be able to use the computer keyboard or the mouse to perform actions on the virtual keypad.
10. Associate to each event a recording schedule for each destination (hard drive, monitor).
11. Automatically display all alarms on screen in text with optional graphic or picture and trigger a sound requiring an acknowledgement on the keyboard to stop the alarm.
12. Alarm pop-ups can be sent to many workstations. An alarm pop-up shall be acknowledged once by one operator.
13. Mandatory comments can be added by the operator when acknowledging the alarm pop-up.
14. In the case of an unacknowledged alarm within a customizable time; the alarm shall be sent to all active operators with additional log information.
15. Each event should print on a log printer. For security reasons, each event shall be incremented with a print number. Numbering shall start from 0 every day.
16. Generate reports and view them on the screen, output them to a printer, or send them to an email address.
17. Supervise based on programmed schedules of specific points such as door contacts, volumetric detectors, mechanical points, high and low temperature sensors, or any other equipment necessary for good building management.

18. View and/or save video images.
19. When integrated into a digital video recording system (American Dynamics), allow the management of the recordings of all the cameras via access system workstations.
    When connected to a digital video recording system (American Dynamics), allow the orientation of all PTZ cameras directly using the workstation mouse of the access system.
20. The SMS shall offer the option to create 4 digit, 5 digit or 6 digit PIN for the card holders.
21. The PIN length shall be defined SMS wide.
22. When connected to a digital video recording system (American Dynamics), allow the recovery and storage of selected videos to an independent server.
23. Save the database manually or automatically backup following a schedule.
24. Uninterrupted backups. The operator shall be able to perform any task during a SMS backup.
25. The operator shall be able to perform any and all operations during a fail-over synchronization between the primary server and redundant server.
26. The SMS shall remind SMS operators via email and messages (pop-ups) of the SMS KAP status. The SMS shall have pre-defined reminders set to:
    a. 60 days before KAP expiration
    b. 30 days before KAP expiration
    c. Day of KAP expiration
    d. 30 days after KAP expiration
27. The SMS KAP reminder shall include but not be limited to SMS serial number tokens needed and SMS Edition.
28. When the access control system manages parking lot entry and exit, it shall be possible to set a maximum number of vehicles authorized to simultaneously access the parking area. Once the parking lot is full, the system shall prevent access to any cardholder for as long as a parking space has not become available.
29. Allow for a Dual Custody option to add extra security to a door by requesting that two card holders must access the door together.
30. It shall be possible to program on KT-400 controller readers a double and triple switch function:
    a. It shall be possible to have activate the multi-swipe function a predetermined schedule
    b. The double and triple swipes shall be able to be activated on reader simultaneously each with their respective actions.
    c. The multi-swipe function shall be able to but not limited to:
        i. Toggle door unlock
        ii. Unlock door
        iii. Relock door
        iv. Temporarily unlock door
        v. Activate Relay
        vi. Temporarily activate relay
        vii. Arm door partition request when using a Multi-Site gateway
31. Each card holder shall have the option of having the multi-swipe function active.
32. A specific event shall be generated for any valid or invalid, double or triple swipes.
33. Save events on a hard drive according to required criteria.

34. Perform the following operations from all workstations:
    a. Lock or unlock, one time unlock, return to schedule one door or a group of doors.
    b. Temporarily unlock a door using a custom timer for additional door unlocking on KT-400 controller doors
    c. Disable and enable readers
    d. View custom programmed comments in the component's Operation section.
    e. Activate or deactivate a relay or a group of relays.
    f. Activate or deactivate the recording of one camera or a group of cameras.
    g. Activate or deactivate a point or a group of points.
    h. Program or modify one card or a group of cards.
    i. Validate or invalidate one card or a group of cards.
    j. Change time and date.
    k. Demand the system state in text or graphic mode.
    l. Query, create and/or modify data on: Access levels, Schedules and holidays, Access card, Instructions, Reports and log, Doors, Supervision points and relays, Operator levels, and Graphics.
    m. Ability to use an easy to use system tree view to select the components.
    n. View which cards are in the roll call sectors.
    o. View the card's last known access in the roll call sector.
35. Perform the following operations from the SmartLink Task Commander:
    a. Alarm
    b. Disable and enable any reader.
    c. Lock, unlock, temporary unlock return to schedule, disable enable any elevator and elevator floor.
    d. Activate, deactivate, temporary activate, toggle and return to schedule of any relay.
    e. Shunt, unshunt, temporary shunt, toggle, return to schedule and continuous supervision of any input.
    f. Set count usage, manually overwrite the count, disable count usage, decrement count usage, increment count usage for all the cards.
    g. Send alarm emails.
    h. The use of variables in the SmartLink Task Commander can be used instead of hard coded values.
    i. Mass card modifications on without operator intervention.
    j. Ability to use generically created commands to perform task on different components.
    k. Each specific card shall have the ability to activate a specific component in the above mentioned states without the need to create hard coded the commands.
    l. The SmartLink Task Commander shall process the commands on the first available SmartLink on the SMS.
        i. The use of a specific SmartLink to run a specific SmartLink Task Commander shall not be accepted.
        ii. The SMS all allow for many SmartLinks to be installed without the need to purchase additional option codes.
        iii. The SmartLink Task Commander shall be run from any of the available SmartLink.
        iv. The Smartlink Task commander shall allow for single or grouping of components of the same type to trigger the same task. The need to have a specific trigger programmed per component to trigger the same task shall not be accepted.

2.9 EQUIPMENT

A. Server and Redundant Server Requirements

The SMS server and redundant server shall meet the following minimum requirements:

1. The server shall have a Dual core processor or better
    a. If doing video the server shall have an Intel Core 2 Quad core processor or better
2. The server shall have a 500-watt power unit
3. The server shall have 2 GB RAM.
4. The server shall have 20 GB hard disk drive space.

a. If doing video the server shall have 30 GB with video server more more

5. The server shall have a 48x CD-ROM drive
6. The server operating system shall be Windows XP Pro 32- bit. Windows 2003 Standard and Enterprise Server Edition/ Vista Enterprise, / Windows 2008 Server/Windows 7. All OS's shall be 32-bit or 64-bit.
7. The server shall have a 10/100/1000 Base-T network adapter
8. The server shall have a high quality multilingual keyboard
9. The server shall have a two button ergonomic mouse
10. The server shall have an On-Off switch
11. The server shall have an appropriate UPS

B. Multi-Site Gateway Requirements

The SMS Multi-Site gateway shall meet the following minimum requirements:

1. The Multi-Site gateway shall have an Dual core processor or better
2. The Multi-Site gateway shall have a 500-watt power unit
3. The Multi-Site gateway shall have 2 GB RAM.
4. The Multi-Site gateway shall have 20 GB hard disk drive space.
5. The Multi-Site gateway shall have a 48x CD-ROM drive
6. The server operating system shall be Windows XP Pro 32- bit. Windows 2003 Standard and Enterprise Server Edition/ Vista Enterprise, / Windows 2008 Server/Windows 7. All OS's shall be 32-bit or 64-bit.
7. Multi-Site. The Multi-Site gateway shall have a 10/100/1000 Base-T network adapter
8. The Multi-Site gateway shall have a high quality multilingual keyboard
9. The Multi-Site gateway shall have a two button ergonomic mouse
10. The Multi-Site gateway shall have an On-Off switch
11. The Multi-Site gateway shall have an appropriate UPS

C. Workstation Requirements

The SMS workstations shall meet the following minimum requirements:

1. The workstation shall have a Dual core processor or better
2. The workstation shall have a 500-watt power unit
3. The workstation shall have 2 GB RAM.
4. The workstation shall have 20 GB hard disk drive space.
5. The workstation shall have a 48x CD-ROM drive

6. The server operating system shall be Windows XP Pro 32- bit. Windows 2003 Standard and Enterprise Server Edition/ Vista Enterprise, / Windows 2008 Server/Windows 7. All OS's shall be 32-bit or 64-bit.
7. The workstation shall have a 10/100/1000 Base-T network adapter
8. The workstation shall have a high quality multilingual keyboard
9. The workstation shall have a two button ergonomic mouse
10. The workstation shall have an On-Off switch
11. The workstation shall have an appropriate UPS

D. Controllers

The SMS shall support the following door controllers:

1. Kantech KT-400
2. The KT-400 is an Ethernet-ready four door controller with sixteen monitored points, on-board door strike power, sixteen reader outputs, four relay outputs, and auxiliary power output. It shall accept Wiegand, proximity, ABA clock and data, bar code, magnetic, integrated keypad, and smart card reader types. It shall also support FIPS 201 cards, with and without checking the expiration date. It supports RS-232, RS-485 and 128-bit AES Encrypted Ethernet 10/100Base-T communication. It supports expansion modules to provide 256 inputs and 256 outputs. It shall support 136 double end of line inputs. It shall support up to support 8 card formats (9 with DUAL ioProx driver). The KT-400 shall support native 20 intervals per schedule.
3. Kantech KT-300
   The KT-300 is a two door controller with eight monitored points on board expandable to sixteen, door strike power, auxiliary power output, and two auxiliary outputs. It shall accept Wiegand, proximity, bar code, magnetic and integrated keypad reader types. It supports RS-232, RS-485, and Combus communication. It supports relay, input, and output expansion modules. The KT-300 is available in 128k and 512k memory versions.
4. Kantech KT-100
   The KT-100 is a one door controller with four monitored points, door strike power, and four auxiliary outputs. It shall accept Wiegand, proximity, bar code, magnetic and integrated keypad reader types. It supports RS-485 communication.
5. Kantech KT-200 (Legacy)

E. KTES (Kantech Telephone Entry System)

1. The KTES enables tenants to grant access to the building, to their visitors, via their own telephone line or cellular telephone. The KTES supports 250 tenants with the option of supporting up to 3000 tenants. The KTES also includes:
   - 4 lines x 20 characters LCD module with controllable LED backlighting
   - Programming menus available in three (3) languages (English, French and Spanish)
   - Built-in RS-485
   - 128-bit AES encrypted Ethernet
   - Internal modem
   - Three (3) relays
   - Microphone

- Speaker
- Backup battery

2. Optional KTES accessories are:
   - Heater kit
   - Postal lock
   - Color camera
   - Goose neck mounting
   - Paper index (flush mounted)

3. The KTES shall be programmed via the keypad and LCD for stand alone mode or via the SMS.
4. The unit shall support a Wiegand reader that will allow tenants to wipe their cards and enter the building.

5. The KTES shall employ flashable firmware with auto update.

F. Card and Reader Support

1. The SMS shall support configuration of unlimited card formats.
2. The SMS shall support up to 2 card formats per KT-100 and KT-300 controller (3 with DUAL ioProx driver).
3. The SMS shall support up to 8 card formats per KT-400 controller (9 with DUAL ioProx driver).
4. The SMS shall support readers that provide Wiegand signaling and magnetic ABA signaling to include:

   a. Kantech ioProx family of readers
   b. Wiegand swipe readers
   c. Proximity readers
   d. Biometric readers
   e. Smart card readers
   f. Wireless readers
   g. Magnetic readers

PART 3 – EXECUTION

3.1 INSTALLATION

A. System installation shall be in full accordance with the Project Drawings, these Specifications, NFPA Standards, and the manufacturer's published recommendations. All junction boxes shall be painted green to indicate closed circuit television system wiring.

B. All equipment and products furnished shall be UL listed and labeled, and connection shall comply with construction standards.

C. Grounding shall be provided and connected in strict accordance with manufacturer's installation recommendations.

D. Protection, Cleaning, and Adjustment

1. Protection from damage and contamination shall be provided for all system components, devices, and equipment during the entire installation and until acceptance testing.
2. Damaged or contaminated devices and/or components shall be replaced before final testing.
3. Final system adjustment shall be provided before final acceptance testing.

3.2 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting controls, focusing cameras, and sensitivities to suit actual occupied conditions. Provide up to three visits at eight hours a piece to the site for this purpose.

3.3 SYSTEM INITIALIZING AND PROGRAMMING

A. System shall be turned on and adjustment made to meet requirements of specifications and on-site conditions.
B. System shall be programmed to function as specified, and a copy shall be made of the initial program and made available to the owner.

C. Any special programming shall be documented and a written copy made available to the owner.

3.4 WARRANTY

A. The contractor shall provide a warranty on the physical installation of not less than one year at no cost to the owner. Information, with regard to the proper procedures to follow if needed should be included with the warranty. They should include but not be limited to; contact name, contact telephone number, project reference, anticipated response time.

3.5 TESTING

A. The software shall be entered into the SMS computer systems and debugged. The Contractor shall be responsible for documenting and entering the initial database into the system. The Contractor shall provide the necessary blank forms with instructions to fill-in all the required data information that will make up the database. The database shall then be reviewed by the Contractor and entered into the system. Prior to full operation, a complete

demonstration of the computer real-time functions shall be performed. A printed validation log shall be provided as proof of operation for each software application package. In addition, a point utilization report shall be furnished listing each point, the associated programs utilizing that point as an input or output and the programs which that point initiates.

B. Upon satisfactory on-line operation of the system software, the entire installation including all subsystems shall be inspected. The Contractor shall perform all tests, furnish all test equipment and consumable supplies necessary and perform any work as required to establish performance levels for the system in accordance with the specifications. Each device shall be tested as a working component of the completed system. All system controls shall be inspected for proper operation and response.

C. Tests shall demonstrate the response time and display format of each different type of input sensor and output control device. Response time shall be measured with the system functioning at full capacity. Computer operation shall be tested with the complete data file.

D. The Contractor shall maintain a complete log of all inspections and tests. Upon final completion of system tests, a copy of the log records shall be submitted as part of the as-built documentation.

3.6 TRAINING

The Contractor shall provide a competent trainer who has extensive experience on the installed systems and in delivering training to provide the instruction. As an alternate, the Contractor may propose the use of factory training personnel and coordinate the number of personnel to be trained.

3.7 MAINTENANCE

1. The Contractor shall offer a Kantech Advantage Program (KAP) to provide twelve additional months of free software updates and online training for the end user.
2. Technical support is available at no charge to all Kantech dealers whether or not they have a KAP activated for the systems they are supporting.

END OF SECTION 284000

SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Perforated-wall pipe and fittings.
2. Geotextile filter fabrics.

1.3 ACTION SUBMITTALS

A. Product Data:
1. Geotextile filter fabrics.
2. Perforated-wall pipe and fittings.

1.4 QUALITY ASSURANCE

A. Delegated Design: Hydraulic calculations, engineering, and pipe sizing for foundation and retaining wall drainage systems shall be the responsibility of the design/build subcontractor or the Civil engineer of record.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings:

1. NPS 6 (DN 150) and Smaller: ASTM F405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
2. NPS 8 (DN 200) and Larger: ASTM F667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
3. Couplings: Manufacturer's standard, band type.

B. Perforated PVC Sewer Pipe and Fittings: ASTM D2729, bell-and-spigot ends, for loose joints.

2.2 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4480 to 13 440 L/min. per sq. m) when tested according to ASTM D4491.

B. Structure Type: Nonwoven, needle-punched continuous filament.

1. Survivability: AASHTO M 288 Class 2
2. Styles: Flat and sock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Excavating, trenching, and backfilling shall be specified on the Civil site improvements documents.

3.3 FOUNDATION DRAINAGE INSTALLATION

A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches (150 mm) deep and 12 inches (300 mm) wide.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches (100 mm).

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.

F. Add drainage course to width of at least 6 inches (150 mm) on side away from wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping to width of at least 6 inches (150 mm) on side away from footing and above top of pipe to within 12 inches (300 mm) of finish grade.

H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

I. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches (100 mm).

J. Install drainage panels on foundation walls as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at base of footing. Install as indicated in Part 3 "Piping Installation" Article.
3. Separate 4 inches (100 mm) of fabric at beginning of roll and cut away 4 inches (100 mm) of core. Wrap fabric around end of remaining core.
4. Attach panels to wall beginning at subdrainage pipe. Place and secure molded-sheet drainage panels, with geotextile facing away from wall.

K. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches (150 mm). Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.4 RETAINING-WALL DRAINAGE INSTALLATION

A. Place supporting layer of drainage course over compacted subgrade to compacted depth of not less than 4 inches (100 mm).

B. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

C. Add drainage course to width of at least 6 inches (150 mm) on side away from wall and to top of pipe to perform tests.

D. After satisfactory testing, cover drainage piping to width of at least 6 inches (150 mm) on side away from footing and above top of pipe to within 12 inches (300 mm) of finish grade.

E. Place drainage course in layers not exceeding 3 inches (75 mm) in loose depth; compact each layer placed and wrap top of drainage course with flat-style geotextile filter fabric.

F. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches (100 mm).

G. Install drainage panels on wall as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at base of footing as described elsewhere in this Specification. Do not install aggregate.
3. If weep holes are used instead of drainage pipe, cut 1/2-inch- (13-mm-) diameter holes on core side at weep-hole locations. Do not cut fabric.
4. Mark horizontal calk line on wall at a point 6 inches (150 mm) less than panel width above footing bottom. Before marking wall, subtract footing width.
5. Separate 4 inches (100 mm) of fabric at beginning of roll and cut away 4 inches (100 mm) of core. Wrap fabric around end of remaining core.
6. Attach panel to wall at horizontal mark and at beginning of wall corner. Place core side of panel against wall. Use concrete nails with washers through product. Place nails from 2 to 6 inches (50 to 150 mm) below top of panel, approximately 48 inches (1200 mm) apart. Do not penetrate waterproofing. Before using adhesives, discuss with waterproofing manufacturer.
7. If another panel is required on same row, cut away 4 inches (100 mm) of installed panel core and wrap fabric over new panel.
8. If additional rows of panel are required, overlap lower panel with 4 inches (100 mm) of fabric.
9. Cut panel as necessary to keep top 12 inches (300 mm) below finish grade.
10. For inside corners, bend panel. For outside corners, cut core to provide 3 inches (75 mm) for overlap.

H. Fill to Grade: Place satisfactory soil fill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches (150 mm). Thoroughly compact each layer. Fill to finish grade.

3.5 LANDSCAPING DRAINAGE INSTALLATION

A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches (100 mm).

D. Install drainage conduits as indicated in Part 3 "Piping Installation" Article for landscaping subdrainage with horizontal distance of at least 6 inches (150 mm) between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with flat-style geotextile filter fabric before installation. Connect fabric sections with adhesive or tape.

E. Add drainage course to top of drainage conduits.

F. After satisfactory testing, cover drainage conduit to within 12 inches (300 mm) of finish grade.

G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches (100 mm).

I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches (150 mm). Thoroughly compact each layer. Fill to finish grade.

3.6 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Foundation Subdrainage: Install piping level and with a minimum cover of 36 inches (915 mm) otherwise indicated.
2. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping level and with a minimum cover of 36 inches (915 mm) unless otherwise indicated.
3. Landscaping Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches (915 mm) unless otherwise indicated.
4. Lay perforated pipe with perforations down.
5. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install thermoplastic piping according to ASTM D2321.

3.7 PIPE JOINT CONSTRUCTION

A. Join perforated PE pipe and fittings with couplings according to ASTM D3212 with loose banded, coupled, or push-on joints.

B. Join perforated PVC sewer pipe and fittings according to ASTM D3212 with loose bell-and-spigot, push-on joints.

C. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.8 CLEANOUT INSTALLATION

A. Comply with requirements for cleanouts specified in Section 334100 "Storm Utility Drainage Piping."

B. Cleanouts for Foundation, Retaining-Wall and Landscaping Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. In vehicular-traffic areas, use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set top of cleanout flush with grade.
3. In nonvehicular-traffic areas, use NPS 4 (DN 100) PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches (300 by 300 by 100 mm) deep. Set top of cleanout 1 inch (25 mm) above grade.
4. Comply with requirements for concrete specified in Section 033000 "Cast-in-Place Concrete."

3.9 CONNECTIONS

A. Comply with requirements for piping specified in Section 334100 "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.10 IDENTIFICATION

A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Section 312000 "Earth Moving."

1. Install PE warning tape or detectable warning tape over ferrous piping.
2. Install detectable warning tape over nonferrous piping and over edges of underground structures.

3.11 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600

Appendix 1 – Proposed UL Design Assemblies

UL Index

	UL Design No.
Steel Assemblies	
1. 1 Hour rated column assembly	- X526
2. 1 Hour rated column assembly	- X650
3. 1 Hour rated beam assembly	- X649
Fire Wall Assemblies	
1. 2 Hour fire wall assembly	- U347
Shaft Wall Assemblies	
1. 2 Hour CMU shaft wall assembly	- U905
Fire Barrier/Partition wall Assemblies	
1. 1 Hour wood wall & bearing wall assembly	- U305
2. 1 Hour wood separation wall assembly	- U341
Wood Floor/Clg & Roof Assemblies	
1. 1 Hour wood floor/clg assembly	- L521
2. 1 Hour stair wood floor/clg assembly	- L598
3. 1 Hour Wood roof assembly	- P531
4. 1 Hour Wood roof assembly	- Gypsum Assoc. File No. RC 2601
Head of Wall Assemblies	
1. 1 & 2 Hour rated assembly	- HW-D-0088
Rated Floor Through-Penetration Assemblies	
1. 1 Hour rated nonmetallic pipe penetration assembly	- F-C-2008
2. 1 Hour rated drain pipe penetration assembly	- F-C-2026
3. 1 Hour rated nonmetallic pipe in chase wall assembly	- F-C-2030
4. 1 Hour rated cable penetration assembly	- F-C-3007
5. 1 Hour rated steel pipe penetration assembly	- F-C-5002

Rated Wall Through-Penetration Assemblies

1. 1 & 2 Hour rated nonmetallic pipe penetration assembly - W-L-2093
2. 1 & 2 Hour rated nonmetallic pipe penetration assembly - W-L-2101
3. 1 & 2 Hour rated cable penetration assembly - W-L-3001
4. 1 & 2 Hour rated cable bundle penetration assembly - W-L-3076
5. 1 & 2 Hour rated metallic pipe penetration assembly - W-L-5040
6. 1 & 2 Hour rated steel vent pipe penetration assembly - W-L-7019

UL DESIGN X526

FIRE-RESISTANCE DESIGN

Assembly Usage Disclaimer

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

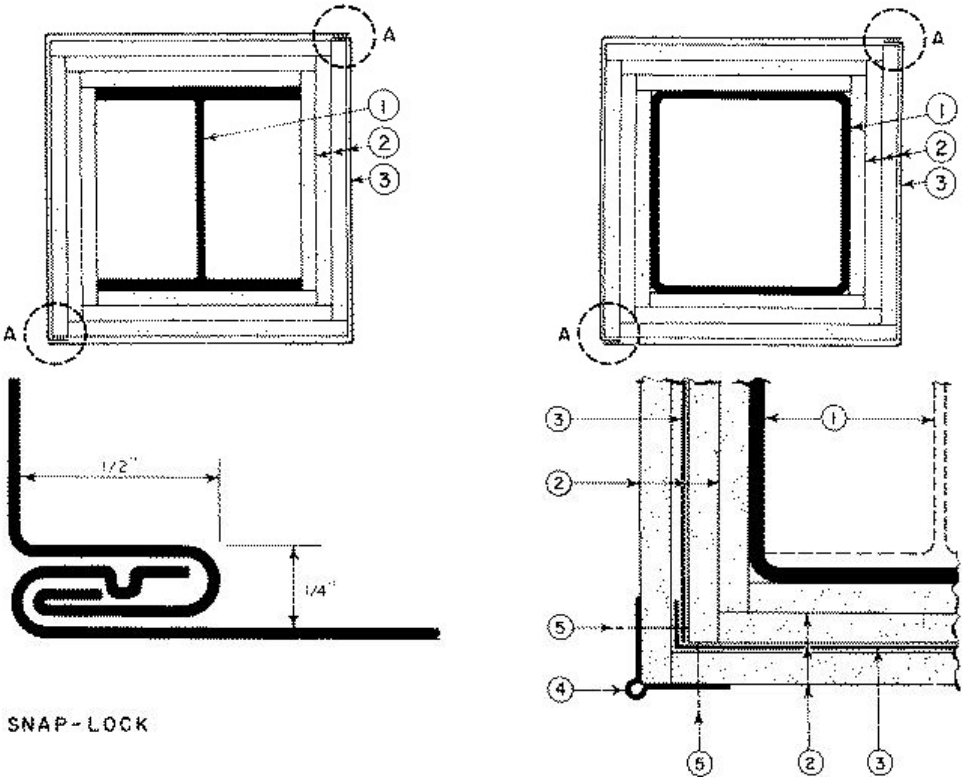
See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

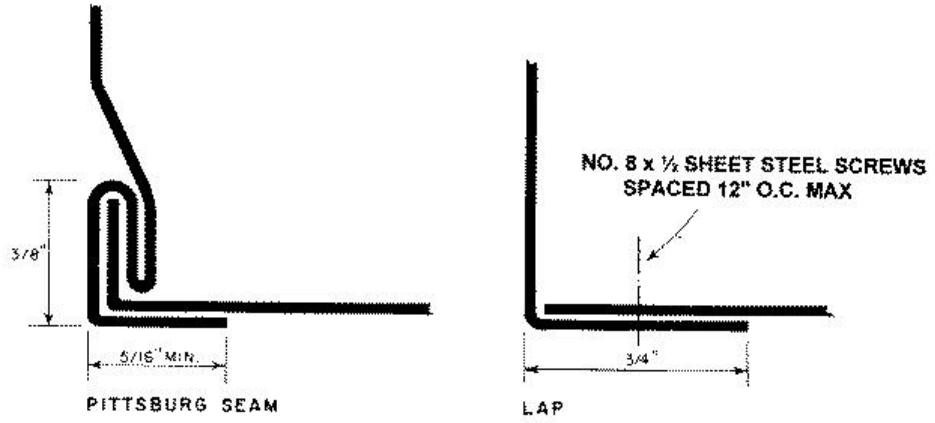
Design No. X526

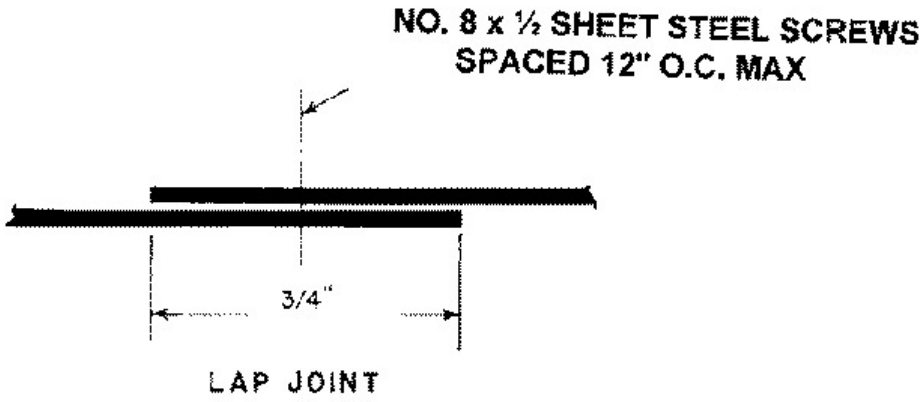
December 26, 2018

Ratings — 1, 2, 3 and 4 Hr.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**







1. **Steel Column —** Min sizes of W shape and tubular steel columns in the AISC Steel Construction Manual as shown under Item 2.

2. **Gypsum Board —** — **Any 1/2 in. thick UL Classified Gypsum Board that is eligible for use in Design No. X515. Any 5/8 in. thick UL Classified Gypsum Board that is eligible for use in Design Nos. L501, G512 or U305**. Nom 5/8 in. thick or 1/2 in. thick gypsum board. Min total thicknesses of layers in inches for the various ratings and min column sizes are as follows:

W Shape Columns								
	Min Column Size				Rating Hr			
Dsg	Outside Dimensions In.	Flange Thkns In.	Web Thkns In.	In.^{2} Area	Total Thkns of Layers of Wallboard In. 1	2	3	4
W4x13	4-1/8x4	0.345	0.280	3.82	1	1-1/2	2-1/4	—
W6x15.5	6x6	0.269	0.235	4.56	1	1-1/2	2-1/4	3-1/8
W10x49	10x10	0.558	0.340	14.4	1/2	1-1/8	1-7/8	2-1/2

Tubular Shape Columns							
				Rating Hr			
				Total Thkns of			
	Min Column Size			Layers of Wallboard In.			
Dsg	Outside Dimensions In.	Thkns In.	In.^{2} Area	1	2	3	4

TS4X4X0.188	4X4	0.188	2.74	1	1-3/4	2-5/8	-
TS4.5X4.5X0.250	4.5X4.5	0.25	3.84	5/8			
TS8X8X0.250	8X8	0.250	7.48	5/8	1-1/2	2-1/2	-

Applied in layers as shown in above illustration. Each layer held together with paper masking adhesive tape during erection to allow placement of succeeding layers.

For column ratings of 2 hr or less, one layer of gypsum board may be applied to the outer surface of steel cover. Boards applied vertically, without horizontal joints, attached to cover with screws located 1 in. from the board edge and 8 in. OC.

ACADIA DRYWALL SUPPLIES LTD (View Classification) — CKNX.R25370

AMERICAN GYPSUM CO (View Classification) — CKNX.R14196

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO (View Classification) — CKNX.R19374

CERTAINTEED GYPSUM INC (View Classification) — CKNX.R3660

CGC INC (View Classification) — CKNX.R19751

CONTINENTAL BUILDING PRODUCTS OPERATING CO, L L C (View Classification) — CKNX.R18482

GEORGIA-PACIFIC GYPSUM L L C (View Classification) — CKNX.R2717

LOADMASTER SYSTEMS INC (View Classification) — CKNX.R11809

NATIONAL GYPSUM CO (View Classification) — -eXP-C, CKNX.R3501

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM (View Classification) — CKNX.R7094

PANEL REY S A (View Classification) — CKNX.R21796

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD (View Classification) — CKNX.R19262

THAI GYPSUM PRODUCTS PCL (View Classification) — CKNX.R27517

UNITED STATES GYPSUM CO (View Classification) — CKNX.R1319

USG BORAL DRYWALL SFZ LLC (View Classification) — CKNX.R38438

USG MEXICO S A DE C V (View Classification) — CKNX.R16089

2A. **Gypsum Board* —** As an alternate to Item 2, 3/4 in. thick applied as described in Item 2.
CGC INC — Type IP-X3 or ULTRACODE

UNITED STATES GYPSUM CO — Type IP-X3 or ULTRACODE

USG BORAL DRYWALL SFZ LLC — Type ULTRACODE

USG MEXICO S A DE C V — Type IP-X3 or ULTRACODE

2B. **Gypsum Board* —** (As an alternate to Items 2 and 2A) — Nominal 5/8 in. thick panels. One of the layers of Gypsum Board (Item 2) used to obtain the minimum required thickness in Item 2 may be substituted with one layer and secured as described in Item 2.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock ES

2C. **Wall and Partition Facings and Accessories* —** (As an alternate to Items 2 through 2B) — Composite **Gypsum Panel** — Nominal 5/8 in. thick panels. One of the layers of Gypsum Board (Item 2) used to obtain the minimum required thickness in Item 2 may be substituted with one layer of composite gypsum panel and secured as described in Item 2.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock 527

3. **Steel Covers — For seamed joints —** 0.024 in. min thickness (No. 24 MSG) uncoated, galv or stainless steel, for column ratings of 3 hr or less. For 4 hr ratings, only stainless steel cover to be used. Covers consist of two L-shaped sections with Snap-Lock or Pittsburgh sheet steel joints. Width to be determined on the basis of protection thickness and column size. Length of sections to provide 1/8 in. clearance per lineal foot of column length between cover and any restraint.
For lapped joints — (Max ratings 2 hr) — No. 22 MSG (0.027 in. thick) uncoated or galv steel. Fasteners used at laps to be No. 8 by 1/2 in. steel sheet metal screws spaced a max of 12 in. O.C. Other details to be the same as those stated for seamed joints as shown above.

4. **Corner Bead —** For columns with outer layer of wallboard attached to outside surface of metal cover, No. 28 MSG galv steel, 1-1/4 in. legs corner beads attached to wallboard with screws spaced 12 in. O.C.

5. **Screws —** For columns with outer layer of wallboard attached to outside surface of metal cover, self-drilling Phillips bugle head, 1 in. long screws for 1/2 or 5/8 in. thick wallboard (1-1/4 in. long screws for 3/4 in. thick wallboard) are used to attach wallboard to steel cover, and corner bead to wallboard.

6. **Sodium Silicate Solution —** (Not shown, optional) — Used to adhere one layer of wallboard to inside of steel cover prior to assembly.

7. **Finishing System —** (Not shown) — Joint compound applied over corner beads to a thickness of 1/16in.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2018-12-26

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.

- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

The appearance of a company's name or product in this database does not in itself assure that products so identified have been manufactured under UL's Follow-Up Service. Only those products bearing the UL Mark should be considered to be Certified and covered under UL's Follow-Up Service. Always look for the Mark on the product.

UL DESIGN X650

BXUV.X650 - Fire-resistance Ratings - ANSI/UL 263

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See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. X650

November 09, 2020

Ratings - 1, 1-1/2, 2 and 3 Hr. (See Item 2)

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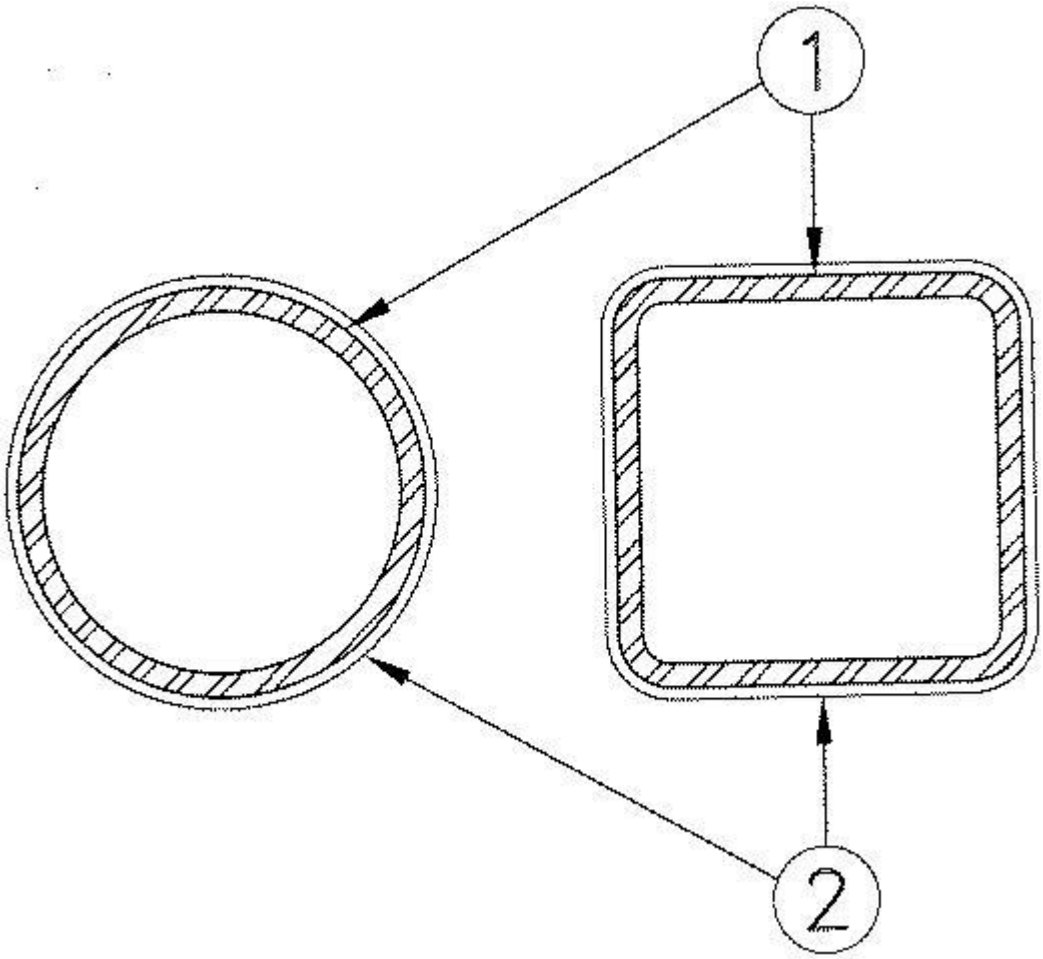

1. **Steel Column —** Steel tube (ST) or steel pipe (SP) with the minimum sizes shown in the table below. Columns shall be free of dirt, loose scale and oil. Columns shall be primed with a phenolic modified alkyd resin primer.

2. **Intumescent Fire-resistive Materials* —** Coating spray, brush or trowel applied directly from containers to desired thickness. See table below for appropriate final dry thickness and applicable rating.

FOR STEEL PIPE

			1 Hr		1-1/2 Hr		2 Hr		3 Hr	
Steel Size	**A/P**	**Hp/A**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**
SP 4.5 x 0.313	0.29	135	0.117	2.99	—	—	—	—	—	—
SP 8 x 0.875	0.79	49	0.097	2.46	0.097	2.46	0.120	3.05	0.216	5.50
SP 8.625 x 0.5	0.47	85	0.097	2.46	0.138	3.50	0.202	5.14	0.364	9.25
SP 16 x 0.625	0.60	65	—	—	—	—	—	—	0.285	7.25

FOR SQUARE AND RECTANGULAR STEEL TUBE

			1 Hr		1-1/2 Hr		2 Hr		3 Hr	
Steel Size	**A/P**	**Hp/A**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in.**	**mm**
ST3.5x3.5x3/16	0.18	224	0.165	4.18	—	—	—	—	—	—
ST5x3x1/4	0.23	169	0.104	2.65	0.252	6.39	0.400	10.15	—	—
ST5x3x5/16	0.29	135	0.084	2.13	0.218	5.54	0.353	8.96	—	—

ST8x6x3/8	0.35	114	0.074	1.87	0.173	4.40	0.280	7.12	—	—
ST8x6x7/16	0.41	100	0.074	1.87	0.151	3.84	0.244	6.21	—	—
ST5x3x1/2	0.44	93	0.074	1.87	0.127	3.23	0.207	5.27	—	—
ST8x8x1/2	0.47	85	0.074	1.87	0.095	2.41	0.164	4.17	0.327	8.31

BERLIN CO LTD — Type WB 3, Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB 4, Investigated for Exterior Use with top coat as described in Item 3

GREENTECH ASIA PACIFIC SDN BDH — Type WB 3, Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB 4, Investigated for Exterior Use with top coat as described in Item 3

GREENTECH THERMAL INSULATION PRODUCTS MFG CO L L C — Type WB 3, Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB 4, Investigated for Exterior Use with top coat as described in Item 3

ISOLATEK INTERNATIONAL — Type SprayFilm-WB 3 and Type WB 3, Investigated for Interior General Purpose . Type SprayFilm-WB 4 and Type WB 4, Investigated for Interior General Purpose. Type SprayFilm-WB 4 and Type WB 4, Investigated for Exterior Use with top coat as described in Item 3

NEWKEM PRODUCTS CORP — Type WB 3, Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB 4, Investigated for Exterior Use with top coat as described in Item 3

3. **Top Coat —** Type SprayFilm — TOPSEAL and Type TOPSEAL required for Exterior Use, applied at a minimum dry thickness of 14 mils (0.34 mm) over the intumescent material.

See Classification information in the **Mastic and Intumescent Coating** (CDWZ) category, Isolatek International, for mixing requirements.

Investigated for Interior General Purpose.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2020-11-09

UL DESIGN X649

BXUV.X649 - Fire-resistance Ratings - ANSI/UL 263

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BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. X649

November 09, 2020

Ratings - 1, 1-1/2, 2, 3 and 4 Hr. (See Item 2)

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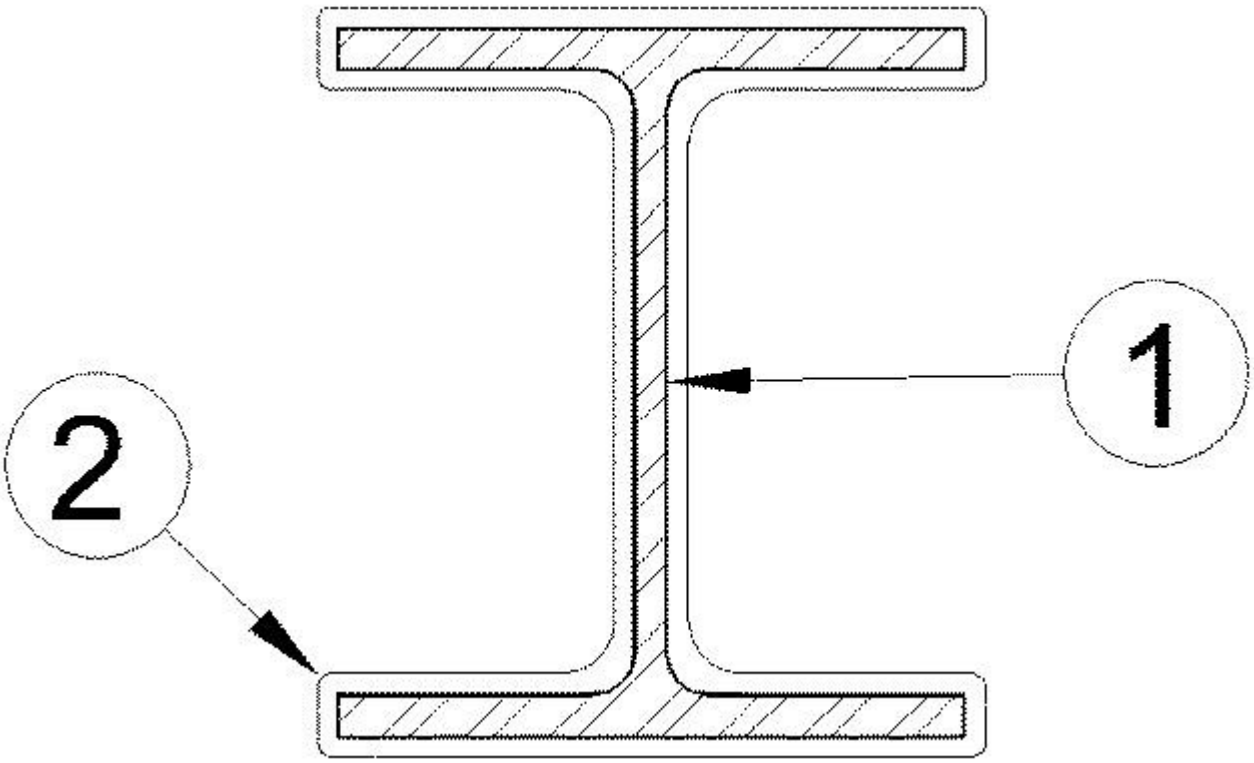


1. **Steel Column —** Wide flange steel columns with the minimum sizes shown in the tables below. Columns shall be free of dirt, loose scale and oil. Columns shall be primed with a phenolic modified alkyd resin primer, a metal alkyd primer, an acrylic primer or an epoxy primer at a nominal thickness of 2 mil.

2. **Intumescent Fire-resistive Materials* —** Coating spray, brush or trowel applied directly from containers to desired thickness. See tables below for appropriate final dry thickness and applicable rating.

Steel Size	W/D	1 Hr Min Thickness, In.	1-1/2 Hr Min Thickness, In.	2 Hr Min Thickness, In.	3 Hr Min Thickness, In.	4 Hr Min Thickness, In.
W8 x 10	0.33	0.145	0.266	NR	NR	NR
W12 x 14	0.36	0.133	0.263	NR	NR	NR
W12 x 16	0.41	0.117	0.230	NR	NR	NR
W6 x 12	0.44	0.109	0.215	0.338	NR	NR
W8 x 15	0.48	0.100	0.197	0.310	NR	NR
W10 x 22	0.52	0.092	0.182	0.286	NR	NR
W4 x 13	0.55	0.087	0.172	0.271	NR	NR
W6 X 16	0.58	0.083	0.163	0.257	0.504	NR
W8 x 24	0.59	0.075	0.130	0.213	0.504	NR
W14 x 34	0.63	0.075	0.130	0.213	0.489	NR
W8 x 28	0.68	0.070	0.130	0.213	0.453	NR
W8 x 35	0.74	0.065	0.128	0.201	0.416	NR
W10 x 39	0.78	0.061	0.121	0.191	0.395	NR
W10 x 49	0.84	0.057	0.113	0.177	0.367	NR

W10 x 45	0.89	0.054	0.106	0.167	0.346	NR
W16 x 57	0.95	0.050	0.099	0.157	0.324	NR
W8 x 48	1.00	0.048	0.095	0.149	0.308	NR
W14 x 90	1.07	0.045	0.088	0.139	0.288	NR
W10 x 68	1.14	0.042	0.083	0.131	0.270	NR
W18 x 97	1.21	0.040	0.078	0.123	0.255	NR
W10 x 77	1.28	0.038	0.074	0.116	0.241	NR
W16 x 100	1.36	0.036	0.069	0.109	0.227	NR
W10 x 88	1.45	0.034	0.065	0.103	0.213	NR
W14 x 132	1.54	0.032	0.061	0.097	0.200	NR
W12 x 120	1.64	0.030	0.058	0.091	0.188	NR
W33 x 221	1.72	0.028	0.058	0.088	0.188	0.433
W14 x 159	1.77	0.028	0.056	0.085	0.187	0.423
W14 x 176	1.95	0.025	0.051	0.077	0.178	0.384
W14 x 193	2.12	0.023	0.047	0.071	0.164	0.353
W14 x 211	2.30	0.023	0.043	0.066	0.151	0.326
W14 x 233	2.52	0.023	0.040	0.060	0.138	0.297
W14 x 257	2.75	0.023	0.036	0.055	0.126	0.272
W14 x 283	3.00	0.023	0.033	0.050	0.116	0.194

NR = No Rating

As an alternate to the above table, the required thickness of coating (in inches) to be applied to all surfaces of wide flange steel columns for 1 hour ratings, in the W/D range of 0.33 to 1.14, may be determined from the following equation:

T = 0.04785/(W/D)

Where T = Thickness of coating in the range of 0.042 to 0.145 in., W = Weight of steel column in pounds per linear foot, D = Heated perimeter of steel column section in inches.

As an alternate to the above table, the required thickness of coating (in inches) to be applied to all surfaces of wide flange steel columns for 1-1/2 hour ratings, in the W/D range of 0.33 to 1.64, may be determined from the following equation:

T = 0.0945/(W/D)

Where T = Thickness of coating in the range of 0.058 to 0.266 in., W = Weight of steel column in pounds per linear foot, D = Heated perimeter of steel column section in inches.

As an alternate to the above table, the required thickness of coating (in inches) to be applied to all surfaces of wide flange steel columns for 2 hour ratings, in the W/D range of 0.44 to 1.64, may be determined from the following equation:

T = 0.1489/(W/D)

Where T = Thickness of coating in the range of 0.091 to 0.338 in., W = Weight of steel column in pounds per linear foot, D = Heated perimeter of steel column section in inches.

As an alternate to the above table, the required thickness of coating (in inches) to be applied to all surfaces of wide flange steel columns for 3 hour ratings, in the W/D range of 0.58 to 1.64, may be determined from the following equation:

T = 0.3082/(W/D)

Where T = Thickness of coating in the range of 0.188 to 0.504 in., W = Weight of steel column in pounds per linear foot, D = Heated perimeter of steel column section in inches.

As an alternate to the above table, the required thickness of coating (in inches) to be applied to all surfaces of wide flange steel columns for 4 hour ratings, in the W/D range of 1.72 to 3.00, may be determined from the following equation:

T = 0.749/(W/D)

Where T = Thickness of coating in the range of 0.433 to 0.194 in., W = Weight of steel column in pounds per linear foot, D = Heated perimeter of steel column section in inches.

As an alternate to the above, the following table listing metric units may be used.

Steel Size	M/D	Hp/A	1 Hr Min Thickness, mm	1-1/2 Hr Min Thickness, mm	2 Hr Min Thickness, mm	3 Hr Min Thickness, mm	4 Hr Min Thickness, mm
W8 x 10	19.1	412	3.68	6.76	NR	NR	NR
W12 x 14	21.2	371	3.38	6.67	NR	NR	NR
W12 x 16	24.0	327	2.96	5.85	NR	NR	NR
W6 x 12	25.9	303	2.76	5.46	8.60	NR	NR
W8 x 15	28.1	280	2.53	5.00	7.88	NR	NR
W10 x 22	30.4	258	2.34	4.62	7.27	NR	NR
W4 x 13	32.4	242	2.21	4.36	6.88	NR	NR
W6 X 16	33.9	232	2.10	4.14	6.52	12.80	NR
W8 x 24	34.6	227	1.91	3.31	5.42	12.80	NR
W14 x 34	37.1	213	1.91	3.31	5.42	12.43	NR
W8 x 28	40.0	197	1.79	3.31	5.42	11.51	NR
W8 x 35	43.6	181	1.64	3.24	5.11	10.58	NR
W10 x 39	45.4	172	1.56	3.08	4.85	10.04	NR
W10 x 49	49.1	159	1.45	2.86	4.50	9.32	NR
W10 x 45	51.9	151	1.37	2.70	4.25	8.80	NR
W16 x 57	55.9	141	1.28	2.53	3.98	8.24	NR

W8 x 48	58.6	134	1.22	2.40	3.78	7.83	NR
W14 x 90	62.6	125	1.14	2.24	3.53	7.32	NR
W10 x 68	66.9	118	1.07	2.11	3.32	6.87	NR
W18 x 97	71.0	111	1.02	1.98	3.13	6.47	NR
W10 x 77	75.2	105	0.97	1.88	2.95	6.12	NR
W16 x 100	79.4	99	0.91	1.76	2.78	5.76	NR
W10 x 88	84.9	92	0.85	1.66	2.61	5.40	NR
W14 x 132	90.0	87	0.80	1.56	2.46	5.08	NR
W12 x 120	96.2	82	0.75	1.46	2.31	4.77	NR
W33 x 221	100.9	78	0.71	1.47	2.24	4.78	11.0
W14 x 159	103.9	76	0.70	1.43	2.16	4.74	10.7
W14 x 176	114.4	69	0.63	1.30	1.96	4.52	9.75
W14 x 193	124.4	63	0.59	1.19	1.81	4.16	8.97
W14 x 211	135.0	58	0.59	1.10	1.66	3.83	8.28
W14 x 233	147.9	53	0.59	1.00	1.52	3.50	7.54
W14 x 257	161.4	49	0.59	0.92	1.39	3.21	6.91
W14 x 283	176.0	45	0.59	0.84	1.28	2.94	4.92

NR = No Rating

As an alternate to the above table, the required thickness of coating (in mm) to be applied to all surfaces of wide flange steel columns for 1 hour ratings, in the M/D range of 19.1 to 66.9, may be determined from the following equation:

T = 71.6/(M/D)

Where T = Thickness of coating in the range of 1.07 to 3.68 mm, M = Weight of steel column in kilograms per linear meter, D = Heated perimeter of steel column section in meters.

As an alternate to the above table, the required thickness of coating (in mm) to be applied to all surfaces of wide flange steel columns for 1-1/2 hour ratings, in the M/D range of 19.1 to 96.2, may be determined from the following equation:

T = 141.3/(M/D)

Where T = Thickness of coating in the range of 1.46 to 6.76 mm, M = Weight of steel column in kilograms per linear meter, D = Heated perimeter of steel column section in meters.

As an alternate to the above table, the required thickness of coating (in mm) to be applied to all surfaces of wide flange steel columns for 2 hour ratings, in the M/D range of 25.9 to 96.2, may be determined from the following equation:

T = 222.7/(M/D)

Where T = Thickness of coating in the range of 2.31 to 8.60 mm, M = Weight of steel column in kilograms per linear meter, D = Heated perimeter of steel column section in meters.

As an alternate to the above table, the required thickness of coating (in mm) to be applied to all surfaces of wide flange steel columns for 3 hour ratings, in the M/D range of 33.9 to 96.2, may be determined from the following equation:

T = 461.0/(M/D)

Where T = Thickness of coating in the range of 4.77 to 12.80 mm, M = Weight of steel column in kilograms per linear meter, D = Heated perimeter of steel column section in meters.

As an alternate to the above table, the required thickness of coating (in mm) to be applied to all surfaces of wide flange steel columns for 4 hour ratings, in the M/D range of 100.9 to 176.0, may be determined from the following equation:

T =1116.4/(M/D)

Where T = Thickness of coating in the range of 4.92 to 11.0 mm, M = Weight of steel column in kilograms per linear meter, D = Heated perimeter of steel column section in meters.

BERLIN CO LTD — Type WB 3, Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB 4, Investigated for Exterior Use with top coat as described in Item 3

GREENTECH ASIA PACIFIC SDN BDH — Type WB 3, Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB 4, Investigated for Exterior Use with top coat as described in Item 3

GREENTECH THERMAL INSULATION PRODUCTS MFG CO L L C — Type WB 3, Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB 4, Investigated for Exterior Use with top coat as described in Item 3

ISOLATEK INTERNATIONAL — Type SprayFilm-WB 3 and Type WB 3, Investigated for Interior General Purpose. Type SprayFilm-WB 4 and Type WB 4, Investigated for Interior General Purpose. Type SprayFilm-WB 4 and Type WB 4, Investigated for Exterior Use with top coat as described in Item 3

NEWKEM PRODUCTS CORP — Type WB 3, Investigated for Interior General Purpose. Type WB 4, Investigated for Interior General Purpose. Type WB 4, Investigated for Exterior Use with top coat as described in Item 3

3. **Top Coat —** Type SprayFilm — TOPSEAL and Type TOPSEAL required for Exterior Use, applied at a minimum dry thickness of 14 mils (0.34 mm) over the intumescent material.

See Classification information in the **Mastic and Intumescent Coating** (CDWZ) category, Isolatek International, for mixing requirements.

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

Last Updated on 2020-11-09

UL DESIGN U347

FIRE-RESISTANCE DESIGN

Assembly Usage Disclaimer

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. U347

January 11, 2019

Nonbearing Wall Rating — 2 Hr (See Items 4, 4A and 4B) (Separation Wall, See Items 1,2 and 3)

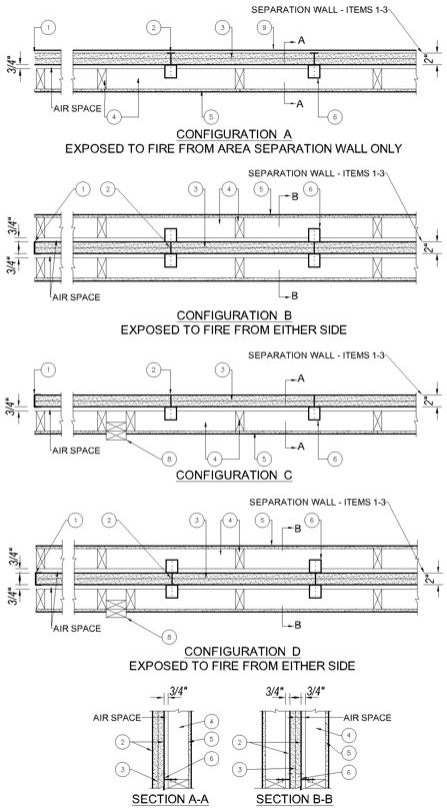
Bearing Wall Rating 2 Hr. (Protected Wall, See Items 4 and 4A)

Nonbearing Wall Rating 2-Hr (Protected Wall, See Item 4, 4A and 4B)

Finish Rating — 120 Min (See Item 4)

STC Ratings — 61, 69, 70 (See Items 7 - 7B)

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



SEPARATION WALL: (Non-bearing, Max Height - 66 ft - see Item 6)

1. **Steel Track —** Floor, sidewall or top wall track. Nom 2 in. wide channel shaped with nom 1 in. long legs, formed from No. 25 MSG galv steel, secured with suitable fasteners spaced 24 in. OC.

2. **Steel Studs —** "H" shaped studs formed from No. 25 MSG galv steel having an overall depth of approximately 2 in. and flange width 1-3/8 in.

3. **Gypsum Board* —** Two layers of 1 in. thick gypsum wallboard liner panels, supplied in nom 24 in. widths. Vertical edges of panels friction fit into "H" shaped studs.
NATIONAL GYPSUM CO — Types FSW, FSW-B, FSW-7, FSW-9

PROTECTED WALL: (Bearing or Nonbearing Wall, as indicated in Items 4, 4A and 4B. When Bearing, Load Restricted for Canadian Applications — See Guide BXUV7.)

4. **Wood Studs —** For Bearing or Nonbearing Wall Rating — Nom 2 by 4 in. max spacing 24 in. OC. Studs cross braced at mid-height where necessary for clip attachment. Min 3/4 in. separation between wood framing and fire separation wall. Finish rating evaluated for wood studs only.

4A. **Steel Studs —** (As an alternate to Item 4, not shown) — For Bearing Wall Rating — Corrosion protected steel studs, min No. 20 MSG (0.0329 in., min bare metal thickness) steel or min 3- 1/2 in. wide, min No. 20 GSG (0.036 in. thick) galv steel or No. 20 MSG (0.033 in. thick) primed steel, cold formed, shall be designed in accordance with the current edition of the Specification for the Design of Cold-Formed Steel Structural Members by the American Iron and Steel Institute. All design details enhancing the structural integrity of the wall assembly, including the axial design load of the studs, shall be as specified by the steel stud designer and/or producer, and shall meet the requirements of all applicable local code agencies. The max stud spacing of wall assemblies shall not exceed 24 in. OC. Studs attached to floor and ceiling tracks with 1/2 in. long Type S-12 steel screws on both sides of studs or by welded or bolted connections designed in accordance with the AISI specifications. Top and bottom tracks shall consist of steel members, min No. 20 MSG (0.0329 in., min bare metal thickness) steel or min No. 20 GSG (0.036 in. thick) galv steel or No. 20 MSG (0.033 in. thick) primed steel, that provide a sound structural connection between steel studs, and to adjacent assemblies such as a floor, ceiling, and/or other walls. Attached to floor and ceiling assemblies with steel fasteners spaced not greater than 24 in. O.C. Studs cross-braced with stud framing at midheight where necessary for clip attachment. Min 3/4 in. separation between steel framing and area separation wall. Finish rating has not been evaluated for Steel Studs.

4B. **Steel Studs —** (As an alternate to Items 4 and 4A, for use in Configuration B only, not shown) — For Nonbearing Wall Rating — Channel shaped, fabricated from min 25 MSG corrosion-protected steel, min 3-1/2 in. wide, min 1-1/4 in. flanges and 1/4 in. return, spaced a max of 24 in. OC. Studs to be cut 3/8 to 3/4 in. less than assembly height. Top and bottom tracks shall be channel shaped, fabricated from min 25 MSG corrosion-protected steel, min width to accommodate stud size, with min 1 in. long legs, attached to floor and ceiling with fasteners 24 in. OC max. Studs cross-braced with stud framing at midheight where necessary for clip attachment. Min 3/4 in. separation between steel framing and area separation wall. Finish rating has not been evaluated for Steel Studs.

5. **Gypsum Board — Classified or Unclassified —** Min 1/2 in. thick, 4 ft wide, applied horizontally or vertically. Wallboard attached to wood studs (Item 4) with 1-1/4 in. long steel drywall screws spaced 12 in. OC. Wallboard attached to steel studs (Item 4A or 4B) with 1 in. long Type S steel screws spaced 12 in. OC. Vertical joints located over studs. Horizontal joints shall be butted tight to form a closed joint. As an option, joints covered with paper tape and joint compound. As an option, screw heads covered with joint compound.

5A. **Plywood Sheathing or OSB —** (not shown) — As an alternate to Item 5, Min 1/2 in. thick plywood or OSB applied horizontally or vertically to wood or steel studs. Vertical joints located over studs. Horizontal joints shall be butted tight to form a closed joint. Fastened to studs with nails or screws of sufficient length, spaced 12 in. OC. Joints and fastener heads are not required to be treated. Aluminum clips shall be spaced as described in Item 6.

5B. **Batts and Blankets* —** (not shown) — As an alternate to Items 5 and 5A, Glass fiber or mineral wool insulation, min. 3-1/2 in. thick, placed to completely fill the wood or steel stud cavities. When Batts and Blankets are used in place of Items 5 and 5A, the max height is 54 ft and the aluminum clips (Item 6) shall be spaced a max of 5 ft OC vertically. See Batts and Blankets (BKNV) category in the Building Materials Directory and Batts and Blankets (BZJZ) category in the Fire Resistance Directory for name of Classified Companies.

5C. **Wall and Partition Facings and Accessories* —** (not shown) — As an alternate to Items 5, 5A and 5B, 4 ft wide panels, applied vertically. Panels attached to wood studs (Item 4) with 1-5/8 in. long steel drywall screws spaced 16 in. OC. Vertical joints located over studs. Joints covered with paper tape and joint compound. As an option, screw heads covered with joint compound.
NATIONAL GYPSUM CO — Type SoundBreak Gypsum Board.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Types QuietRock QR-500, QuietRock QR-510, QuietRock QR-525

6. **Aluminum Clips —** Aluminum angle, 0.049 in. thick, 2 in. wide with 2 in. and 2-1/2 in. legs. Clips secured with Type S screws 3/8 in. long to "H" studs and with 1-1/4 in. long screws to wood framing or steel framing through holes provided in clip.

6A. Clip placement for separation walls up to 23 ft high: Space clips a max of 10 ft OC vertically between wood or steel framing and "H" studs.

6B. Clip placement for separation walls up to 54 ft high: Space clips as described in Item 6A for upper 24 ft. Remaining wall area below requires clips spaced a max of 5 ft OC vertically between wood or steel framing and "H" studs.

6C. Clip placement for separation walls up to 66 ft high: Space clips as described in Item 6A for upper 24 ft, space clips as described in Item 6B for middle 30 ft. Remaining wall area below requires clips spaced a max of 39 in. OC vertically between wood or steel framing and "H" studs.

7. **STC Rating —** The STC Rating of the wall assembly is 61 when it is constructed as described by Items 1 through 6, except:

A. Item 4, above — Wood Studs — Shall be spaced 16 in. OC.

B. Item 5, above — Gypsum Board — Min. weight 1.5 psf. Shall be applied vertically and attached to studs with 1-1/4 in. long steel drywall screws spaced 16 in. OC. Joints and screwheads shall be covered with paper tape and joint compound.

C. Item 6, above — Aluminum Clips — Spaced a max of 10 ft OC vertically.

D. Batts and Blankets* - The cavities formed by the wood studs shall be friction fit with 3-1/2 in. thick fiberglass insulation batts, min. 0.80 pcf. See Batts and Blankets (BKNV) category in the Building Materials Directory and Batts and Blankets (BZJZ) category in the Fire Resistance Directory for name of Classified Companies.

E. Max Height of Separation Wall is 23 ft.

F. The STC rating applies to Configuration B only.

G. Steel Studs (Items 4A, 4B), Plywood Sheathing or OSB (Item 5A and Item 9) and Batts and Blankets (Items 5B) not evaluated as alternatives for obtaining STC rating.

7A. **STC Rating —** The STC Rating of the wall assembly is 69 when it is constructed as described by Items 1 through 6, except:

A. Item 4, above — Wood Studs — Shall be spaced 16 in. OC.

B. Item 5C, above — Wall and Partition Facings and Accessories* — Type QuietRock QR-510 panels shall be installed.

C. Item 6, above — Aluminum Clips — Spaced a max of 10 ft OC vertically.

D. Batts and Blankets* - The cavities formed by the wood studs shall be friction fit with 3-1/2 in. thick fiberglass insulation batts, min. 1.0 pcf. See Batts and Blankets (BKNV) category in the Building Materials Directory and Batts and Blankets (BZJZ) category in the Fire Resistance Directory for name of Classified Companies.

E. Max Height of Separation Wall is 23 ft.

F. The STC rating applies to Configuration B only.

G. Steel Studs (Items 4A, 4B), Plywood Sheathing or OSB (Item 5A and Item 9) and Batts and Blankets (Items 5B) not evaluated as alternatives for obtaining STC rating.

7B. **STC Rating —** The STC Rating of the wall assembly is 70 when it is constructed as described by Items 1 through 6, except:

A. Item 4, above - Wood Studs - Shall be spaced 16 in. OC.

B. Item 5C, above - Wall and Partition Facings and Accessories* - Type QuietRock QR-525 panels shall be installed as described in Item 5C.

C. Item 6, above — Aluminum Clips - Spaced a max of 10 ft OC vertically.

D. Batts and Blankets* — The cavities formed by the wood studs shall be friction fit with 3-1/2 in. thick fiberglass insulation batts, min. 1.0 pcf. See Batts and Blankets (BKNV) category in the Building Materials Directory and Batts and Blankets (BZJZ) category in the Fire Resistance Directory for name of Classified Companies.

E. Max Height of Separation Wall is 23 ft.

F. The STC rating applies to Configuration B only.

G. Steel Studs (Items 4A, 4B), Plywood Sheathing or OSB (Item 5A and Item 9) and Batts and Blankets (Items 5B) not evaluated as alternatives for obtaining STC rating.

8. **Non-Bearing Wall Partition Intersection —** (Optional) Two nominal 2 by 4 in. stud or nominal 2 by 6 in. stud nailed together with two 3in. long 10d nails spaced a max. 16 in. OC. vertically and fastened to one side of the minimum 2 by 4 in. stud with 3 in. long 10d nails spaced a max 16 in. OC. vertically. Intersection between partition wood studs to be flush with the 2 by 4 in. studs. The wall partition wood studs are to be framed with a second 2 by 4 in. wood stud fastened with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Maximum one non-bearing wall partition intersection per stud cavity. Non-bearing wall partition stud depth shall be at a minimum equal to the depth of the wall.

9. **Plywood Sheathing or OSB —** (Optional) — Min 1/2 in. thick plywood or OSB applied horizontally or vertically to "H" studs on area separation wall side of Configuration A or Configuration C. Vertical joints located over studs. Fastened to "H" studs with screws of sufficient length, spaced a maximum of 12 in. OC.

10. **Gypsum Board* —** As an alternate to Item 5 - Min 5/8 in. thick, min. 6 in. wide batten strips, applied on both sides of Steel Studs (Item 2) and horizontal back to back Steel Track (Item 1). Min. 5/8 in. thick, min. 3 in. wide batten strips applied on both sides of single Steel Track (Item 1) at perimeter of assembly. Batten strips secured to studs with 1-1/4 in. long Type S steel screws spaced 12 in. OC. Batten joints shall be butted tight to form a closed joint. As an option, entire sheet of gypsum board may be used in lieu of the battens. Clip placement as in item 6, 6A, 6B, or 6C.
NATIONAL GYPSUM CO — Type FSW-3.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2019-01-11

UL DESIGN U905

FIRE-RESISTANCE DESIGN

Assembly Usage Disclaimer

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. U905

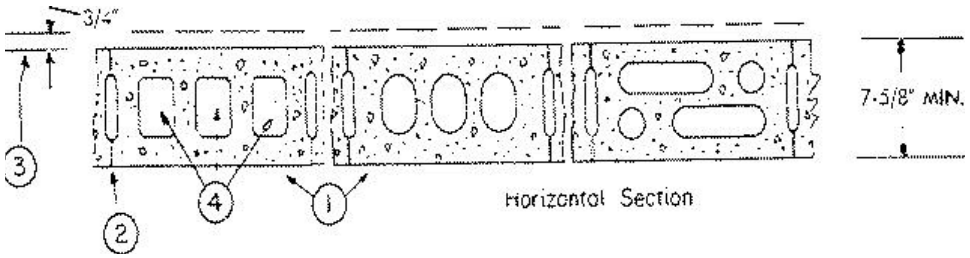
February 18, 2019

Bearing Wall Rating — 2 HR.

Nonbearing Wall Rating — 2 HR

This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



1. **Concrete Blocks* —** Various designs. Classification D-2 (2 hr).
See **Concrete Blocks** category for list of eligible manufacturers.

2. **Mortar —** Blocks laid in full bed of mortar, nom. 3/8 in. thick, of not less than 2-1/4 and not more than 3-1/2 parts of clean sharp sand to 1 part Portland cement (proportioned by volume) and not more than 50 percent hydrated lime (by cement volume). Vertical joints staggered.

3. **Portland Cement Stucco or Gypsum Plaster —** Add 1/2 hr to classification if used. Where combustible members are framed in wall, plaster or stucco must be applied on the face opposite framing to achieve a max. Classification of 1-1/2 hr. Attached to concrete blocks (Item 1).

4. **Loose Masonry Fill —** If all core spaces are filled with loose dry expanded slag, expanded clay or shale (Rotary Kiln Process), water repellant vermiculite masonry fill insulation, or silicone treated perlite loose fill insulation add 2 hr to classification.

5. **Foamed Plastic* —** (Optional-Not Shown) — 1-1/2 in. thick max, 4 ft wide sheathing attached to concrete blocks (Item 1).
ATLAS ROOFING CORP — "EnergyShield Pro Wall Insulation", "EnergyShield Pro 2 Wall Insulation", EnergyShield CGF Pro and EnergyShield Ply Pro

CARLISLE COATINGS & WATERPROOFING INC — Type R2+ SHEATHE

FIRESTONE BUILDING PRODUCTS CO L L C — "Enverge™ CI Foil Exterior Wall Insulation" and "Enverge™ CI Glass Exterior Wall Insulation"

HUNTER PANELS — Types Xci-Class A, Xci 286

RMAX OPERATING L L C — Types "TSX-8500", "ECOMAXci FR", "TSX-8510", "ECOMAX xi FR White", "ECOMAXci", "ECOMAXci FR Air Barrier", "Thermasheath-XP", "Thermasheath", "Durasheath", "Thermasheath-3", "Durasheath-3".

THE DOW CHEMICAL CO — Types Thermax Sheathing, Thermax Light Duty Insulation, Thermax Heavy Duty Insulation, Thermax Metal Building Board, Thermax White Finish Insulation, Thermax ci Exterior Insulation, Thermax XARMOR ci Exterior Insulation, Thermax IH Insulation, Thermax Plus Liner Panel, Thermax Heavy Duty Plus (HDP) and TUFF-R™ ci Insulation

5A. **Building Units —** As an alternate to Items 5, min. 1-in thick polyisocyanurate composite foamed plastic insulation boards, nom. 48 by 48 or 96 in.
RMAX OPERATING L L C — "Thermasheath-SI", "ECOBASEci", "ThermaBase-CI", "ECOMAXci FR Ply", "ECOMAXci Ply".

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2019-02-18

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

The appearance of a company's name or product in this database does not in itself assure that products so identified have been manufactured under UL's Follow-Up Service. Only those products bearing the UL Mark should be considered to be Certified and covered under UL's Follow-Up Service. Always look for the Mark on the product.

UL DESIGN U305

BXUV.U305 - Fire-resistance Ratings - ANSI/UL 263

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. U305

October 06, 2020

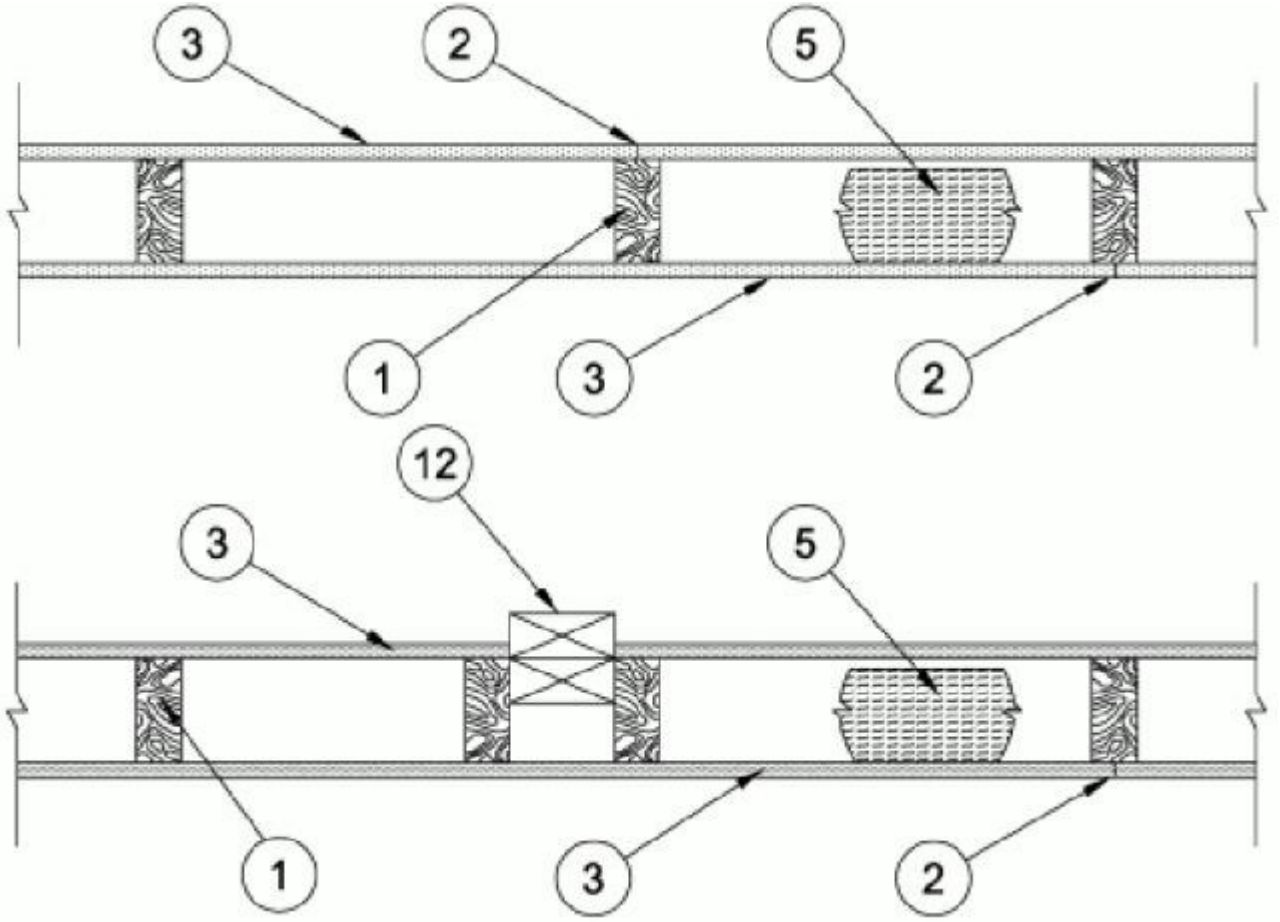
Bearing Wall Rating — 1 Hr

Finish Rating — See Items 3, 3A, 3D, 3E, 3F, 3G, 3H, 3J and 3L.

STC Rating - 56 (See Item 9)

This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



1. **Wood Studs —** Nom 2 by 4 in. spaced 16 in. OC max, effectively firestopped.

2. **Joints and Nail-Heads —** Joints covered with joint compound and paper tape. Joint compound and paper tape may be omitted when square edge boards are used. As an alternate, nom 3/32 in. thick gypsum veneer plaster may be applied to the entire surface of Classified veneer baseboard with the joints reinforced with paper tape. Nailheads exposed or covered with joint compound.

3. **Gypsum Board* —** 5/8 in. thick paper or vinyl surfaced, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads. When used in widths other than 48 in., gypsum panels are to be installed horizontally. For an alternate method of attachment of gypsum panels, refer to Items 6 through 6F, **Steel Framing Members***.

When Items 6, 6B, 6C, 6D, 6E, or 6F, **Steel Framing Members***, are used, gypsum panels attached to furring channels with 1 in. long Type S bugle-head steel screws spaced 12 in. OC.

When Item 6A, **Steel Framing Members***, is used, two layers of gypsum panels attached to furring channels. Base layer attached to furring channels with 1 in. long Type S bugle-head steel screws spaced 12 in. OC. Face layer attached to furring channels with 1-5/8 in. long Type S bugle-head steel screws spaced 12 in. OC. All joints in face layers staggered with joints in base layers. One layer of gypsum board attached to opposite side of wood stud without furring channels as described in Item 3.

When Item 7, resilient channels are used, 5/8 in. thick, 4 ft wide gypsum panels applied vertically. Screw attached furring channels with 1 in. long, self-drilling, self-tapping Type S or S-12 steel screws spaced 8 in. OC, vertical joints located midway between studs.

AMERICAN GYPSUM CO — Types AGX-1(finish rating 23 min.), M-Glass (finish rating 23 min.), Type AGX-11 (finish rating 26 min), Type AGX-12 (finish rating 22 min), Type LightRoc (finish rating 23 min.) or Type AG-C

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO — Type DBX-1 (finish rating 24 min)

CABOT MANUFACTURING ULC — Type X (finish rating 22 min), 5/8 Type X, Moisture Resistant Type X, Gypsum Sheathing Type X, Mold & Mildew Resistant Type X and Mold & Mildew Resistant AR Type X, Type Blueglass Exterior Sheathing

CERTAINTEED GYPSUM INC — Type C, Type X or Type X-1 (finish rating 26 min); Type EGRG or GlasRoc (finish rating 23 min), GlasRoc-2, Type Habito (finish rating 26 min).

CGC INC — Type AR (finish rating 24 min), Type C (finish rating 24 min), Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SCX (finish rating 24 min), Type SHX (finish rating 24 min), Type ULX (finish rating 22 min), Type WRC (finish rating 24 min), Type WRX (finish rating 24 min), Type ULIX (finish rating 20 min)

CERTAINTEED GYPSUM INC — Type LGFC6A (finish rating 34 min), Type LGFC2A, Type LGFC-C/A, Type LGFC-WD, Type LGLLX (finish rating 21 min), Type CLLX (finish rating 24 min)

GEORGIA-PACIFIC GYPSUM L L C — Type 5 (finish rating 26 min), Type 6 (finish rating 23 min), Type 9 (finish rating 26 min), Type C (finish rating 26 min), Type DGG (finish rating 20 min), Type GPFS1 (finish rating 20 min), Type GPFS2 (finish rating 20 min), Type GPFS6 (finish rating 26 min), Type DS, Type DAP, Type DD (finish rating 20 min), Type DA, Type DAPC, Type LS (finish rating 23 min), Type X, Veneer Plaster Base - Type X, Water Rated - Type X, Sheathing - Type X, Soffit - Type X, Type LWX (finish rating 22 min), Veneer Plaster Base-Type LWX (finish rating 22 min), Water Rated-Type LWX (finish rating 22 min), Sheathing Type-LWX (finish rating 22 min), Soffit-Type LWX (finish rating 22 min), Type DGLW (finish rating 22 min), Water Rated-Type DGLW (finish rating 22 min), Sheathing Type- DGLW (finish rating 22 min), Soffit-Type DGLW (finish rating 22 min), Type LWX (finish rating 22 min), Type LW2X (finish rating 22 min), Veneer Plaster Base - Type LW2X (finish rating 22 min), Water Rated - Type LW2X (finish rating 22 min), Sheathing - Type LW2X (finish rating 22 min), Soffit - Type LW2X (finish rating 22 min), Type DGL2W (finish rating 22 min), Water Rated - Type DGL2W (finish rating 22 min), Sheathing - Type DGL2W (finish rating 22 min)

NATIONAL GYPSUM CO — Type FSK (finish rating 20 min), Type FSK-G (finish rating 20 min), Type FSW (finish rating 20 min), Type FSW-2 (finish rating 24 min), Type FSW-3 (finish rating 20 min), Type FSW-5 (finish rating 22 min), Type FSW-G (finish rating 20 min), Type FSK-C (finish rating 20 min), Type FSW-C (finish rating 20 min), Type FSMR-C, Type FSW-6 (finish rating 20 min), Type FSL (finish rating 24 min), Type FSW-8, Type FSLX (finish rating 21 min), Type RSX (finish rating 26 min).

NATIONAL GYPSUM CO — Riyadh, Saudi Arabia — Type FR, or WR.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Types C, PG-2 (finish rating 20 min), PG-3 (finish rating 20 min), Types PG-3W, PG-5W (finish rating 20 min), Type PG-4 (finish rating 20 min), Type PG-6 (finish rating 23 min), Types PG-3WS, PG-5WS, PGS-WRS (finish rating 20 min), Types PG-5, PG-9 (finish rating 26 min), PG-11 PG-13 (Nails increased to 2 in.), Type PG-C or PI (finish rating 26 min)

PANEL REY S A — Type GREX, GRIX, PRX, PRC, PRC2; Types RHX, Guard Rey, MDX, ETX (finish rating 22 min), PRX2 (finish rating 21 min)

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD — Type EX-1 (finish rating 26 min)

THAI GYPSUM PRODUCTS PCL — Type C, Type X (finish rating 26 min)

UNITED STATES GYPSUM CO — Type AR (finish rating 24 min), Type C (finish rating 24 min), Type FRX-G (finish rating 29 min), Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SHX (finish rating 24 min), Type SCX (finish rating 24 min), Type SGX (finish rating 24 min), Type ULX (finish rating 22 min), Type WRX (finish rating 24 min), Type WRC (finish rating 24 min), Type ULIX (finish rating 20 min)

USG BORAL DRYWALL SFZ LLC — Type SGX (finish rating 24 min).

USG MEXICO S A DE C V — Type AR (finish rating 24 min), Type C (finish rating 24 min), Type WRX (finish rating 24 min), Type WRC (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SHX (finish rating 24 min), SCX (finish rating 24 min), Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min), Type ULX (finish rating 22 min)

3A. **Gypsum Board* —** (As an alternate to Item 3) — 5/8 in. thick gypsum panels, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board. When used in widths of other than 48 in., gypsum boards are to be installed horizontally.
AMERICAN GYPSUM CO — Types AGX-1 (finish rating 25 min.), M-Glass (finish rating 25 min.), AG-C (finish rating 25 min.), LighttRoc (finish rating 25 min.)

CERTAINTEED GYPSUM INC — Type C, Type X or Type X-1 (finish rating 26 min)

CGC INC — Type AR (finish rating 24 min), Type C (finish rating 24 min), Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SCX (finish rating 24 min), Type SHX (finish rating 24 min), Type WRC (finish rating 24 min), Type WRX (finish rating 24 min)

NATIONAL GYPSUM CO — Type FSW (finish rating 24 min)

UNITED STATES GYPSUM CO — Type AR (finish rating 24 min), Type SCX (finish rating 24 min), Type SGX (finish rating 24 min), Type C (finish rating 24 min), Type WRX (finish rating 24 min), Type WRC (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SHX (finish rating 24 min), Type FRX-G (finish rating 24 min), Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min)

USG BORAL DRYWALL SFZ LLC — Types C, SCX, SGX (finish rating 24 min).

USG MEXICO S A DE C V — Type AR (finish rating 24 min), Type C (finish rating 24 min), Type WRX (finish rating 24 min), Type WRC (finish rating 24 min), Type IP-X1 (finish rating 24 min), Type IP-X2 (finish rating 24 min), Type SHX (finish rating 24 min), Type SCX, Type IP-AR (finish rating 24 min), Type IPC-AR (finish rating 24 min)

3B. **Gypsum Board* —** (As an alternate to Item 3) — Nom 3/4 in. thick, installed with 1-7/8 in. long cement coated nails as described in Item 3 or 1-3/8 in. long Type W coarse thread gypsum panel steel screws as described in Item 3A.
CGC INC — Types AR, IP-AR

UNITED STATES GYPSUM CO — Types AR, IP-AR

USG MEXICO S A DE C V — Types AR, IP-AR

3C. **Gypsum Board* —** (As an alternate to Items 3, 3A and 3B) — 5/8 in. thick, 2 ft wide, tongue and groove edge, applied horizontally to one side of the assembly. Installed with 1-7/8 in. long cement coated nails as described in Item 3 or 1-1/4 in. long Type W coarse thread gypsum panel steel screws as described in Item 3A. Joint covering (Item 2) not required.
CGC INC — Type SHX

UNITED STATES GYPSUM CO — Type SHX

USG MEXICO S A DE C V — Type SHX

3D. **Gypsum Board* —** (As an alternate to Items 3, 3A, 3B, or 3C — Not Shown) — For Direct Application to Studs Only- Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-5/8 in. long Type W coarse thread gypsum panel steel screws spaced 8 in. OC at perimeter and in the field. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 1-1/2 in.

wide, max 10 ft long with a max thickness of 0.125 in. placed on the face of studs and attached to the stud with two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs or tabs may be used in lieu of or in addition to the lead batten strips or optional at other locations. Max 3/4 in. diam by max 0.125 in. thick lead discs compression fitted or adhered over steel screw heads or max 1/2 in. by 1-1/4 in. by max 0.125 in. thick lead tabs placed on gypsum boards underneath screw locations prior to the installation of the screws. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".
RAY-BAR ENGINEERING CORP — Type RB-LBG (finish rating 24 min)

3E. **Gypsum Board* —** (As an alternate to Items 3, 3A, 3B, 3C, and 3D) — 5/8 in. thick gypsum panels, with square edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last 2 screws 1 and 4 in. from edge of board or nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads. When used in widths of other than 48 in., gypsum boards are to be installed horizontally.
GEORGIA-PACIFIC GYPSUM L L C — Type DGG (finish rating 20 min), GreenGlass Type X (finish rating 23 min)

3F. **Gypsum Board* —** (As an alternate to Items 3, 3A, 3B, 3C, 3D, and 3E) — 5/8 in. glass-mat faced with square edges, applied either horizontally or vertically. Gypsum panels nailed 7 in. OC around the perimeter and in the field with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads. Nails shall be placed 1 inch and 3 inch from horizontal joints and 7 inch OC thereafter.
CGC INC — Type USGX (finish rating 22 min)

UNITED STATES GYPSUM CO — Type USGX (finish rating 22 min.)

USG BORAL DRYWALL SFZ LLC — , Type USGX (finish rating 22 min.)

USG MEXICO S A DE C V — Type USGX (finish rating 22 min.)

3G. **Gypsum Board* —** (As an alternate to Items 3 through 3F) — 5/8 in. thick paper surfaced applied vertically. Gypsum panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads.
GEORGIA-PACIFIC GYPSUM L L C — Type X ComfortGuard Sound Deadening Gypsum Board (finish rating 27 min)

3H. **Gypsum Board* —** (As an alternate to Items 3) — Not to be used with items 6 or 7. 5/8 in. thick paper surfaced applied vertically only. Gypsum panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads.
NATIONAL GYPSUM CO — Type SBWB

3I. **Gypsum Board* —** (As an alternate to Items 3 through 3H, Not Shown) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically. Panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads. Panel joints covered with paper tape and two layers of joint compound. Nailheads covered with two layers of joint compound.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock ES (finish rating 20 min)

3J. **Gypsum Board* —** (As an alternate to Item 3) — Not to be used with items 6 or 7. 5/8 in. thick paper surfaced applied vertically or horizontally. Gypsum panels secured per item 3 or 3A.
CERTAINTEED GYPSUM INC — Type SilentFX

3K. **Gypsum Board* —** (As an alternate to Item 3) — 5/8 in. thick gypsum panels, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a maximum 8 in. OC with the last screw 1 in. from the edge of the board. When used in widths other than 48 in., gypsum panels are to be installed horizontally.
NATIONAL GYPSUM CO — Type FSK (finish rating 20 min), Type FSK-G (finish rating 20 min), Type FSW (finish rating 20 min), Type FSW-2 (finish rating 24 min), Type FSW-3 (finish rating 20 min), Type FSW-5 (finish rating 22 min), Type FSW-G (finish rating 20 min), Type FSK-C (finish rating 20 min), Type FSW-C (finish rating 20 min), Type FSMR-C, Type FSW-6 (finish rating 20 min), Type FSL (finish rating 24 min).

3L. **Gypsum Board* —** (As an alternate to Item 3) — For Direct Application to Studs Only — Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-5/8 in. long Type W coarse thread gypsum panel steel screws spaced 8 in. OC at perimeter and in the field. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 10 ft long with a max thickness of 0.140 in. placed on the face of studs and attached to the stud with two 1 in. long Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs, max 5/16 in. diam by max 0.140 in. thick. compression fitted or adhered over the screw heads. Lead batten strips to have a purity of 99.5% meeting the Federal specification QQ-L-201f, Grades "B, C or D".
MAYCO INDUSTRIES INC — "X-Ray Shielded Gypsum"

3M. **Gypsum Board* —** (As an alternate to Items 3) — For Direct Application to Studs Only — For use as the base layer or as the face layer. Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-5/8 in. long Type W coarse thread gypsum panel steel screws spaced 8 in. OC at perimeter and in the field when applied as the base layer. When applied as the face layer screw length to be increased to 2-1/2 in. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 8 ft long with a max thickness of 0.14 in. placed on the face of studs and attached to the stud with construction adhesive and two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs, nominal 3/8 in. diam by max 0.085 in. thick. Compression fitted or adhered over the screw heads. Lead batten strips and discs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Fasteners for face layer gypsum panels (Items 4, 4A or 4B) when installed over lead backed board to be min 2-1/2 in. Type S-12 bugle head steel screws spaced as described in Item 4.
RADIATION PROTECTION PRODUCTS INC — Type RPP - Lead Lined Drywall

3N. **Gypsum Board* —** (As an alternate to Item 3) — 5/8 in. thick, 4 ft. wide, applied horizontally or vertically with vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Secured as described in Item 3 or 3A.
CERTAINTEED GYPSUM INC — Easi-Lite Type X (finish rating 24 min), Easi-Lite Type X-2 (finish rating 24 min)

3O. **Wall and Partition Facings and Accessories* —** (As an alternate to Item 3, Not Shown) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically. Panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads. Panel joints covered with paper tape and two layers of joint compound. Nailheads covered with two layers of joint compound.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock 527 (finish rating 24 min).

3P. **Gypsum Board* —** (As an alternate to Item 3, Not Shown) — Two layers nom. 5/16 in. thick gypsum panels applied vertically or horizontally. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered or backed by wood studs. Horizontal joints on the same side between face and base layers need not be staggered. Base layer gypsum panels fastened to studs with 1-1/4 in. long drywall nails spaced 8 in. OC. Face layer gypsum panels fastened to studs with 1-7/8 in. long drywall nails spaced 8 in. OC starting with a 4" stagger.
NATIONAL GYPSUM CO — Type FSW (finish rating 25 min)

3Q. **Gypsum Board* —** (As an alternate to Item 3) — 5/8 in. thick gypsum panels, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a maximum 10 in. OC with the last two screws 4 and 1 in. from the edges of the board. When used in widths other than 48 in., gypsum panels are to be installed horizontally.
CERTAINTEED GYPSUM INC — Type LGFC6A (finish rating 21 min), Type LGFC2A, Type LGFC-C/A, Type LGFC-WD, Type LGLLX

3R. **Gypsum Board* —** (As an alternate to Item 3. For use with Item 5H) — Any 5/8 in. thick, 4 ft. wide, Gypsum Board listed in Item 3 above. Applied either horizontally or vertically, and screwed to panels with 1-5/8 in. long Type W coarse thread steel screws at 8 in. OC at perimeter and in the field with the last two screws 4 and 3/4 in. from the edges of the board when applied as the base layer. When used in widths other than 48 in., gypsum panels are to be installed horizontally.

3S. **Gypsum Board* —** 3/4 in. thick paper or vinyl surfaced, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels secured as described in Item 3 with nail length increased to 2 in.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type PG-13

3T. **Wall and Partition Facings and Accessories* —** (As an alternate to 5/8 in. thick board as outlined in Item 3) — Nominal 1-3/8 in. thick, 4 ft wide panels, applied vertically or horizontally. Fastened with #6 x 2 in. long drywall screws spaced 8 in. OC along the perimeter and 12 in. OC in the field.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock 545

3U. **Gypsum Board* —** (As an alternate to Item 3 - For use with Foamed Plastic products, Item 5J) — 5/8 in. thick, 4 ft. wide, applied vertically with vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Gypsum panels nailed 7 in. OC with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 15/64 in. diam heads.
AMERICAN GYPSUM CO — Types AGX-1

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO — Type DBX-1

CABOT MANUFACTURING ULC — Type X

CERTAINTEED GYPSUM INC — Type X

CGC INC — Type SCX

PANEL REY S A — Type PRX

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD — Type EX-1

THAI GYPSUM PRODUCTS PCL — Type X

UNITED STATES GYPSUM CO — Types SCX and SGX

USG BORAL DRYWALL SFZ LLC — Types SCX and SGX

USG MEXICO S A DE C V — Type SCX

3V. **Gypsum Board* —** (As an alternate to Item 3. For use with Item 5K) — Any 5/8 in. thick, 4 ft. wide, Gypsum Board listed in Item 3 above. Applied vertically with vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Gypsum panels secured to studs with 1-5/8 in. long Type W coarse thread gypsum panel steel screws spaced 8 in. OC at perimeter and in the field.

4. **Steel Corner Fasteners —** (Optional) — For use at wall corners. Channel shaped, 2 in. long by 1 in. high on the back side with two 1/8 in. wide cleats protruding into the 5/8 in. wide channel, fabricated from 24 gauge galv steel. Fasteners applied only to the end or cut edge (not along tapered edges) of the gypsum board, no greater than 2 in. from corner of gypsum board, max spacing 16 in. OC. Nailed to adjacent stud through tab using one No. 6d cement coated nail per fastener. Corners of wall board shall be nailed to top and bottom plate using No. 6d cement coated nails.

5. **Batts and Blankets* —** (Optional — Required when Item 6A is used (RC-1)) — Glass fiber or mineral wool insulation. Placed to completely or partially fill the stud cavities. When Item 6A is used, glass fiber or mineral wool insulation shall be friction-fitted to completely fill the stud cavities.
CERTAINTEED CORP

JOHNS MANVILLE

KNAUF INSULATION LLC

MANSON INSULATION INC

ROCKWOOL — Types Acoustical Fire Batts and Type AFB, min. density 1.69 pcf / 27.0 kg/m^3

ROCKWOOL MALAYSIA SDN BHD — Type Acoustical Fire Batts

ROCK WOOL MANUFACTURING CO — Delta Board

THERMAFIBER INC — Type SAFB, SAFB FF

5A. **Fiber, Sprayed* —** (Not Shown — Not for use with Item 6) — As an alternate to Batts and Blankets (Item 5) — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product with a nominal dry density of 2.7 lb/ft^3. Alternate Application Method: The fiber is applied without water or adhesive at a nominal dry density of 3.5 lb/ft^3, in accordance with the application instructions supplied with the product. When Item 6B is used, Fiber, Sprayed shall be INS735, INS745, INS750LD, INS765LD or INS773LD.
U S GREENFIBER L L C — INS735, INS745 and INS750LD for use with wet or dry application. INS515LD, INS541LD, INS735, INS765LD, and INS773LD are to be used for dry application only

5B. **Fiber, Sprayed* —** (Not Shown - Not for use with Item 6) — As an alternate to Batts and Blankets (Item 5) - Spray applied cellulose insulation material. The fiber is applied with water to interior surfaces in accordance with the application instructions supplied with the product. Applied to completely fill the enclosed cavity. Minimum dry density of 4.3 pounds per cubic ft.
NU-WOOL CO INC — Cellulose Insulation

5C. **Batts and Blankets* —** Required for use with resilient channels, Item 7, 3 in. thick mineral wool batts, friction-fitted to fill interior of wall.
THERMAFIBER INC — Type SAFB, SAFB FF

5D. **Glass Fiber Insulation —** (As an alternate to Item 5C) — 3 in. thick glass fiber batts bearing the UL Classification Marking as to Surface Burning and/or Fire Resistance, friction-fitted to fill the interior of the wall. See **Batts and Blankets** (BKNV or BZJZ) Categories for names of Classified companies.

5E. **Batts and Blankets* —** (Required for use with Wall and Partition Facings and Accessories, Item 3D) — Glass fiber insulation, nom 3-1/2 in. thick, min. density of 0.80 pcf, with a flame spread of 25 or less and a smoke developed of 50 or less, friction-fitted to completely fill the stud cavities. See Batts and Blankets Category (BKNV) for names of manufacturers.

5F. **Fiber, Sprayed* —** (Optional, Not Shown — Not for use with Items 6, 6A, 6B, 6C, or 6D) — As an alternate to Batts and Blankets (Item 5) and Item 5A - Spray applied granulated mineral fiber material. The fiber is applied with adhesive, at a minimum density of 4.0 pcf, to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. See **Fiber, Sprayed** (CCAZ).
AMERICAN ROCKWOOL MANUFACTURING, LLC — Type Rockwool Premium Plus

5G. **Fiber, Sprayed* —** (Optional, Not Shown — Not for use with Items 6, 6A, 6B, 6C, or 6D). — As an alternate to Batts and Blankets (Item 5) and Item 5A - Brown Colored Spray applied cellulose fiber. The fiber is applied with water to completely fill the enclosed stud cavity in accordance with the application instructions supplied with the product. The minimum dry density shall be 4.30 lbs/ft^3.
INTERNATIONAL CELLULOSE CORP — Celbar-RL

5H. **Foamed Plastic* —** (Optional -For use with Item 3R) — Spray applied, foamed plastic insulation, at any thickness from partial fill to completely filling stud cavity.
SES FOAM INC — Nexseal™ 2.0 or Nexseal™ 2.0 LE Spray Foam and Sucraseal Spray Foam.

5I. **Fiber, Sprayed* —** (Not Shown — Not for use with Item 6) — As an alternate to Batts and Blankets (Item 5) - Spray-applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. To facilitate the installation of the material, any thin, woven or non-woven netting may be attached by any means possible to the outer face the studs. The material shall reach equilibrium moisture content before the installation of materials on either face of the studs. The minimum dry density shall be 5.79 lbs/ft^3.
APPLEGATE HOLDINGS L L C — Applegate Advanced Stabilized Cellulose Insulation

5J. **Foamed Plastic* —** (Optional, Not Shown - For use with Item 3U) — Spray applied, foamed plastic insulation, at any thickness from partial fill to completely filling stud cavity.
GACO WESTERN L L C — Types GacoEZSpray F4500, GacoProFill FR6500R, Gaco 052N, GacoOnePass F1850, GacoOnePass Low GWP F1880, and Gaco WallFoam 183M

5K. **Foamed Plastic* —** (Optional, Not Shown - For use with Item 3V) — Spray applied, foamed plastic insulation, at any thickness from partial fill to completely filling stud cavity.
CARLISLE SPRAY FOAM INSULATION — SealTite Pro Closed Cell (CC), SealTite Pro Open Cell (OC), SealTite Pro OCX, SealTite Pro No Trim, and SealTite Pro One Zero.

6. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6a) to studs. Clips spaced 48 in. OC. RSIC-1 and RSIC-1 (2.75) clips secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. RSIC-V

and RSIC-V (2.75) clips secured to studs with No. 8 x 1-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips. RSIC-1 and RSIC-V clips for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) and RSIC-V (2.75) clips for use with 2-23/32 in. wide furring channels.
PAC INTERNATIONAL L L C — Types RSIC-1, RSIC-V, RSIC-1 (2.75), RSIC-V (2.75)

6A. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members on one side of studs as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. Batts and Blankets placed in stud cavity as described in Item 5. Two layers of gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Aa) to one side of studs only. Clips spaced 48 in. OC., and secured to studs with two No. 8 x 2-1/2 in. coarse drywall screws, one through the hole at each end of the clip. Furring channels are friction fitted into clips.
KINETICS NOISE CONTROL INC — Type Isomax

6B. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-3/8 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Ba) to studs. Clips spaced 48 in. OC. Genie clips secured to studs with No. 8 x 1-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
PLITEQ INC — Type Genie Clip

6C. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire. Gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Ca) to studs. Clips spaced 48 in. OC., and secured to studs with No. 2 in. coarse drywall screw with 1 in. diam washer through the center hole. Furring channels are friction fitted into clips.
STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237 or A237R

6D. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC, and perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and secured in place with a double strand of No. 18 AWG twisted steel wire. Gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Da) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
REGUPOL AMERICA — Type SonusClip

6E. **Steel Framing Members* —** (Optional, Not Shown) — Resilient channels and Steel Framing Members as described below:

a. **Resilient Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC, and perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and secured in place with two No. 8 15 x 1/2 in. Philips Modified Truss screws spaced 2-1/2 in. from the center of the overlap. Gypsum board attached to resilient channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach resilient channels (Item 6Ea) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Resilient channels are secured to clips with one No. 10 x 1/2 in. pan-head self-drilling screw.
KEENE BUILDING PRODUCTS CO INC - Type RC+ Assurance Clip

6F. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-23/32 in. wide by 7/8 in. or 1-1/2 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Fa) to studs. Clips spaced 48 in. OC. Clips secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. Furring channels are friction fitted into clips.
CLARKDIETRICH BUILDING SYSTEMS — Type ClarkDietrich Sound Clip

6G. **Steel Framing Members* —** (Optional, Not Shown) — Used as an alternate method to attach resilient channels to wall studs. A resilient sound isolation accessory shall be used at each attachment point of the resilient channels and spaced max 16 in. O.C. Channel ends butted and centered under the structural members and attached with one accessory at each end. Additional accessories used to hold resilient channels that support the gypsum board end joints. The accessory envelops the mounting edge of the resilient channel. The accessory and resilient channel are fastened to the structural members with the screws supplied with the accessory and per the accessory manufacturer's installation instructions.
PAC INTERNATIONAL L L C — Type RC-1 Boost

7. **Furring Channel —** Optional — Not Shown — For use on one side of the wall - Resilient channels, 25 MSG galv steel, spaced vertically 24 in. OC, flange portion screw attached to one side of studs with 1-1/4 in. long diamond shaped point, double lead Phillips head steel screws. When resilient channels are used, insulation, Items 5C or 5D is required.

8. **Caulking and Sealants —** (Not Shown, Optional) — A bead of acoustical sealant applied around the partition perimeter for sound control.

9. **STC Rating —** The STC Rating of the wall assembly is 56 when it is constructed as described by Items 1 through 6, except:

A. Item 2, above — Nailheads Shall be covered with joint compound.

B. Item 2, above — Joints As described, shall be covered with fiber tape and joint compound.

C. Item 5, above — Batts and Blankets* The cavities formed by the studs shall be friction fit with R-19 unfaced fiberglass insulation batts measuring 6-1/4 in. thick and 15-1/4 in. wide.

D. Item 6, above — Steel Framing Members* Type RSIC-1 clips shall be used to attach gypsum board to studs on either side of the wall assembly.

E. Item 8, above — Caulking and Sealants (Not Shown) A bead of acoustical sealant shall be applied around the partition perimeter for sound control.

F. Steel Corner Fasteners (Item 4), Fiber, Sprayed (Items 5A and 5B) and Steel Framing Members (Item 6A), not evaluated as alternatives for obtaining STC rating.

10. **Wall and Partition Facings and Accessories* —** (Optional, Not Shown) — Nominal 1/2 in. thick, 4 ft wide panels, for optional use as an additional layer on one or both sides of the assembly. Panels attached in accordance with manufacturer's recommendations. When the QR-500 or QR-510 panel is installed between the wood framing and the UL Classified gypsum board, the required UL Classified gypsum board layer(s) is/are to be installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock QR-500 and QR-510

11. **Cementitious Backer Units* —** (Optional Item Not Shown — For Use On Face Of 1 Hr Systems With All Standard Items Required) - 7/16 in., 1/2 in., 5/8 in., 3/4 in. or 1 in. thick, min. 32 in. wide. Applied vertically or horizontally with vertical joints centered over studs. Fastened to studs and runners with cement board screws of adequate length to penetrate stud by a minimum of 3/8 in. for steel framing members, and a minimum of 3/4 in. for wood framing members spaced a max of 8 in. OC. When 4 ft. wide boards are used, horizontal joints need not be backed by framing.
NATIONAL GYPSUM CO — Type DuraBacker, PermaBase, DuraBacker Plus, or PermaBase Plus

12. **Non-Bearing Wall Partition Intersection —** (Optional) —Two nominal 2 by 4 in. studs or nominal 2 by 6 in. studs nailed together with two 3 in. long 10d nails spaced a max. 16 in. OC. vertically and fastened to one side of the minimum 2 by 4 in. stud with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Intersection between partition wood studs to be flush with the 2 by 4 in. studs. The wall partition wood studs are to be framed by with a second 2 by 4 in. wood stud fastened with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Maximum one non-bearing wall partition intersection per stud cavity. Non-bearing wall partition stud depth shall be at a minimum equal to the depth of the bearing wall.

13. **Mesh Netting —** (Not Shown) — Any thin, woven or non-woven fibrous netting material attached with staples to the outer face of one row of studs to facilitate the installation of the sprayed fiber from the opposite row.

14. **Mineral and Fiber Board* —** (Optional, Not Shown) — For optional use as an additional layer on one side of wall. Nom 1/2 in. thick, 4 ft wide with long dimension parallel and centered over studs. Attached to framing with 2 in. long Type W steel screws, spaced 12 in. OC. The required UL Classified gypsum board layer(s) is/are to be installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
HOMASOTE CO — Homasote Type 440-32

14A. **Mineral and Fiber Board* —** (Optional, Not Shown) — For use with Items 14B-14E) — For optional use as an additional layer on one side of wall. Nom 1/2 in. thick, 4 ft wide with long dimension parallel and centered over studs. Attached to framing with minimum 1-3/8 in. long ring shanked nails or 1-1/4 in. long Type W steel screws, spaced 12 in. OC along board edges and 24 in. OC in field of board along intermediate framing. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
HOMASOTE CO — Homasote Type 440-32

14B. **Glass Fiber Insulation —** (For use with Item 14A) — 3-1/2 in. thick glass fiber batts bearing the UL Classification Marking as to Surface Burning and/or Fire Resistance, placed to fill the interior of the wall. See Batts and Blankets (BKNV or BZJZ) categories for names of Classified companies.

14C. **Batts and Blankets* —** (As an alternate to Item 14B, For use with Item 14A), 3 in. thick mineral wool batts, placed to fill interior of wall, attached to the 3-1/2 in. face of the studs with staples placed 24 in. OC.
THERMAFIBER INC — Type SAFB, SAFB FF

14D. **Adhesive —** (For use with Item 14A) — Construction grade adhesive applied in vertical, serpentine, nominal 3/8 in. wide beads down the length of both vertical edges of Mineral and Fiber Board (Item 14A).

14E. **Gypsum Board* —** (For use with Item 14A) — 5/8 in. thick, 4 ft wide, applied vertically over Mineral and Fiber Board (Item 14A) with vertical joints located anywhere over stud cavities. Secured to mineral and fiber boards with 1-1/2 in. Type G Screws spaced 8 in. OC along edges of each vertical joint and 12 in. OC in intermediate field of the Mineral and Fiber Board (Item 14A). Secured to outermost studs and bearing plates with 2 in. long Type S screws spaced 8 in. OC. Gypsum Board joints covered with paper tape and joint compound. Screw heads covered with joint compound. Finish Rating 30 Min.
AMERICAN GYPSUM CO — Type AG-C

CERTAINTEED GYPSUM INC — Type C

CGC INC — Types C, IP-X2, IPC-AR

CERTAINTEED GYPSUM INC — Type LGFC-C/A

GEORGIA-PACIFIC GYPSUM L L C — Types 5, DAPC, TG-C

NATIONAL GYPSUM CO — Types FSK-C, FSW-C

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type PG-C

PANEL REY S A — Type PRC

THAI GYPSUM PRODUCTS PCL — Type C

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR

14F. **Mineral and Fiber Board —** (Optional, Not Shown) — For optional use as an additional layer on one side of wall - Nom 1/2 in. thick, 4 ft wide, square edge fiber boards applied vertically to studs on one side of the wall in between the wood studs and the UL Classified Gypsum Board (Item 3). Fiber boards installed with 1-1/4 in. long, Type W, bugle head, coarse thread gypsum board screws spaced 12 in. OC max, with the last screws spaced 2 in. and 6 in. from edge of board. Gypsum board (Item 3) installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
BLUE RIDGE FIBERBOARD INC — SoundStop

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

The appearance of a company's name or product in this database does not in itself assure that products so identified have been manufactured under UL's Follow-Up Service. Only those products bearing the UL Mark should be considered to be Certified and covered under UL's Follow-Up Service. Always look for the Mark on the product.

UL DESIGN U341

BXUV.U341 - Fire-resistance Ratings - ANSI/UL 263

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. U341

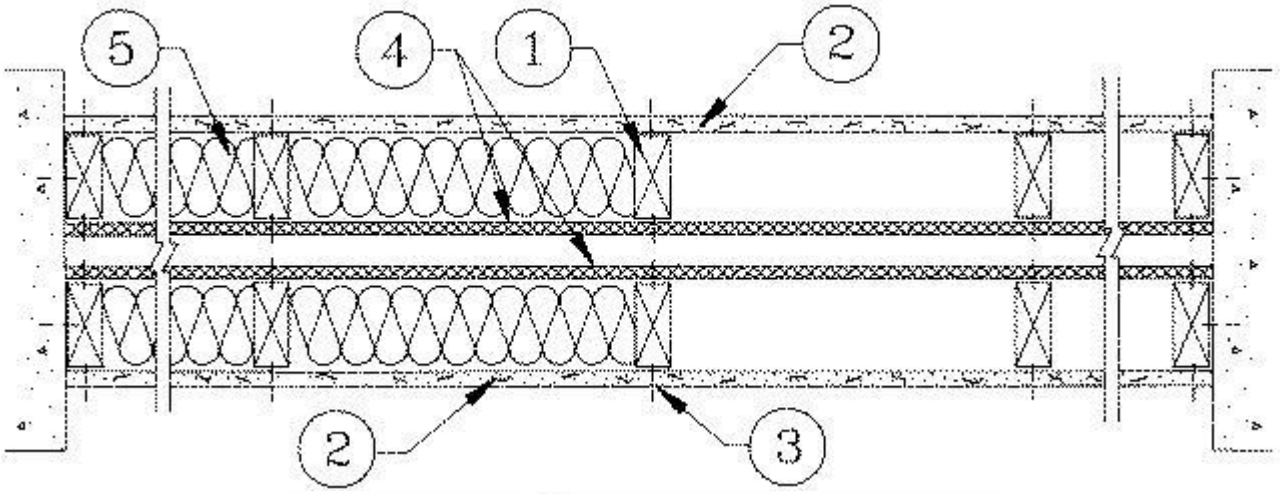
September 23, 2020

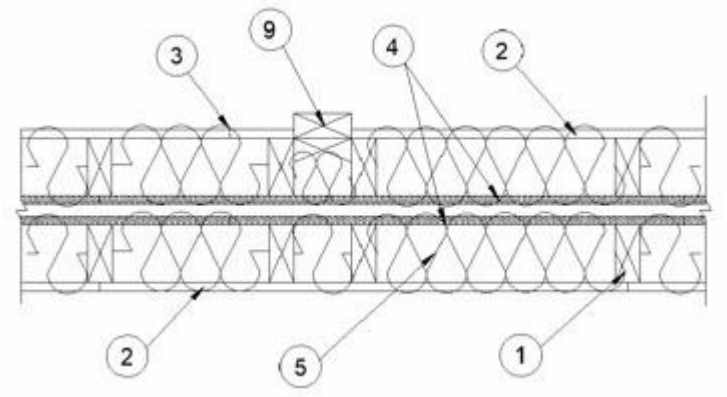
Bearing Wall Rating — 1 Hr.

Finish Rating — Min 20 min.

This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**





HORIZONTAL SECTION

1. **Wood Studs —** Nom 2 by 4 in., spaced 24 in. OC max. Cross braced at mid-height and effectively firestopped at top and bottom of wall. No min. air space between stud rows except to accommodate attachment of sheathing, where required. See items 4 and 5.

2. **Gypsum Board* — Any 5/8 in. thick UL Classified Gypsum Board that is eligible for use in Design Nos. L501, G512 or U305.** Nom 5/8 in. thick 4 ft wide. Gypsum board applied horizontally or vertically, unless specified below, and nailed to studs and bearing plates 7 in. OC with 6d cement coated nails, 1-7/8 in. long, 0.0915 in. shank diam and 1/4 in. diam head. As an alternate, No. 6 bugle head drywall screws, 1-7/8 in. long, may be substituted for the 6d cement coated nails.
When **Steel Framing Members*** (Item 6 or any alternate clips) are used, wallboard attached to furring channels with 1 in. long Type S bugle-head steel screws spaced 12 in. OC.

When used in widths other than 48 in., gypsum board to be installed horizontally.

AMERICAN GYPSUM CO (View Classification) — CKNX.R14196

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO (View Classification) — CKNX.R19374

CABOT MANUFACTURING ULC (View Classification) — CKNX.R25370

CERTAINTEED GYPSUM INC (View Classification) — CKNX.R3660

CGC INC (View Classification) — CKNX.R19751

CERTAINTEED GYPSUM INC (View Classification) — CKNX.R18482

GEORGIA-PACIFIC GYPSUM L L C (View Classification) — CKNX.R2717

LOADMASTER SYSTEMS INC (View Classification) — CKNX.R11809

NATIONAL GYPSUM CO (View Classification) — CKNX.R3501

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM (View Classification) — CKNX.R7094

PANEL REY S A (View Classification) — CKNX.R21796

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD (View Classification) — CKNX.R19262

THAI GYPSUM PRODUCTS PCL (View Classification) — CKNX.R27517

UNITED STATES GYPSUM CO (View Classification) — CKNX.R1319

USG BORAL DRYWALL SFZ LLC (View Classification) — CKNX.R38438

USG BORAL DRYWALL SFZ LLC (View Classification) — CKNX.R38438

USG MEXICO S A DE C V (View Classification) — CKNX.R16089

2A. **Gypsum Board* —** (As an alternate to Item 2, not shown) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically to studs and bearing plates on one side of the assembly with 1-5/8 in. long Type S screws spaced 12 in. OC at perimeter of panels and 8 in. OC in the field. Horizontal joints of vertically applied panels need not be backed by studs. Panel joints covered with paper tape and two layers of joint compound. Screwheads covered with two layers of joint compound. Batts and Blankets placed in stud cavity as described in Item 5C. Not evaluated for use with Steel Framing Members, Furring Channels or Fiber, Sprayed.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock QR-530 (finish rating 23 min).

2B. **Gypsum Board* —** (As an alternate to Item 2, not shown) — Any 5/8 in. thick gypsum panels that are eligible for use in Design Nos. L501, G512 or U305, supplied by the Classified companies listed below shown in the **Gypsum Board*** (CKNX) category. Applied horizontally or vertically and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board. When used in widths other than 48 in., gypsum board to be installed horizontally.
UNITED STATES GYPSUM CO

USG BORAL DRYWALL SFZ LLC

USG MEXICO S A DE C V

2C. **Gypsum Board* —** (As an alternate to Item 2, Not Shown) — 5/8 in. thick gypsum panels applied horizontally or vertically and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board. When used in widths other than 48 in., gypsum board to be installed horizontally.
AMERICAN GYPSUM CO — Types AGX-1, M-Glass, AG-C, LightRoc

CERTAINTEED GYPSUM INC — Type C, Type X or Type X-1

NATIONAL GYPSUM CO — Type FSK, Type FSK-G, Type FSW, Type FSW-3, Type FSW-5, Type FSW-G, Type FSK-C, Type FSW-C, Type FSMR-C, Type FSW-6, Type FSL

THAI GYPSUM PRODUCTS PCL — Type C or Type X

2D. **Gypsum Board* —** (As an alternate to Items 2, 2A, 2B and 2C) — 5/8 in. thick gypsum panels, with square edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last 2 screws 1 and 4 in. from edge of board or nailed as described in Item 2. When used in widths of other than 48 in., gypsum boards are to be installed horizontally.
GEORGIA-PACIFIC GYPSUM L L C — GreenGlass Type X, Type DGG.

2E. **Gypsum Board* —** (As an alternate to Items 2 through 2D) — 5/8 in. thick, 4 ft. wide, paper surfaced applied vertically only and secured as described in Item 2.
GEORGIA-PACIFIC GYPSUM L L C — Type X ComfortGuard Sound Deadening Gypsum Board.

2F. **Gypsum Board* —** (As an alternate to Items 2 through 2E) - Installed as described in Item 2. 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically only and fastened to the studs and plates with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 1/4 in. diam heads, 7 in. OC. Not for use with item #6.
NATIONAL GYPSUM CO — Type SBWB

2G. **Gypsum Board* —** (As an alternate to Items 2 through 2F) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically and secured as described in Item 2.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Types QuietRock ES.

2H. **Gypsum Board* —** (As an alternate to Items 2 through 2G) — Installed as described in Item 2. 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically or horizontally fastened to the studs and plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board.
CERTAINTEED GYPSUM INC — Type SilentFX

2I. **Wall and Partition Facings and Accessories* —** (As an alternate to Items 2 through 2H) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically and secured as described in Item 2.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock 527.

2J. **Gypsum Board* —** (As an alternate to 5/8 in. Type FSW in Item 2) — 2 layers nom. 5/16 in. thick gypsum panels applied vertically or horizontally. Horizontal joints on the same side need not be staggered. Inner layer attached with fasteners, as described in item 2, spaced 24 in. OC. Outer layer attached per Item 2.
NATIONAL GYPSUM CO — Type FSW.

2K. **Gypsum Board* —** (As an alternate to Item 2) — 5/8 in. thick gypsum panels, with beveled, square, or tapered edges, applied either horizontally or vertically. Gypsum panels fastened to framing with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a maximum 10 in. OC with the last two screws 4 and 1 in. from the edges of the board. When used in widths other than 48 in., gypsum panels are to be installed horizontally.
CERTAINTEED GYPSUM INC — Type LGFC6A (finish rating 21 min), Type LGFC2A, Type LGFC-C/A, Type LGFC-WD, Type LGLLX

3. **Joints and Nailheads —** Gypsum board joints of outer layer covered with tape and joint compound. Nail heads of outer layer covered with joint compound. As an alternate, nom 3/32 in. thick gypsum veneer plaster may be applied to the entire surface of Classified veneer baseboard with joints reinforced with paper tape.

4. **Sheathing —** (Optional) — Septum may be sheathed with min 7/16 in. thick wood structural panels min grade "C-D" or "Sheathing" or min 1/2 in. thick **Mineral and Fiber Boards***.

See **Mineral and Fiber Boards** (CERZ) category for names of Classified companies.

5. **Batts and Blankets* —** 3-1/2 in. max thickness glass or mineral fiber batt insulation. **Optional** when sheathing (Item 4) is used on both halves of wall.

See **Batts and Blankets** (BZJZ) category for list of Classified companies.

5A. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 5) — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product with a nominal dry density of 2.7 lb/ft^3. Alternate Application Method: The fiber is applied without water or adhesive at a nominal dry density of 3.5 lb/ft^3, in accordance with the application instructions supplied with the product.
U S GREENFIBER L L C — INS735, INS745 and INS750LD for use with wet or dry application. INS515LD, INS541LD, INS735, INS765LD, and INS773LD are to be used for dry application only.

5B. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 5) when Sheathing (Item 4) is used on both halves of wall - Spray applied cellulose insulation material. The fiber is applied with water to interior surfaces in accordance with the application instructions supplied with the product. Applied to completely fill the enclosed cavity. Minimum dry density of 4.3 pounds per cubic ft.
NU-WOOL CO INC — Cellulose Insulation

5C. **Batts and Blankets* —** (Required for use with Wall and Partition Facings and Accessories, Item 2A. Use of Sheathing, Item 4, does not nullify requirement of Item 5C for use with Item 2A) — Glass fiber insulation, nom 3-1/2 in. thick, min. density of 0.80 pcf, with a flame spread of 25 or less and a smoke developed of 50 or less, friction-fitted to completely fill the stud cavities. See Batts and Blankets Category (BKNV) for names of manufacturers.

5D. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 5) and Item 5A when Sheathing (Item 4) is used on both halves of wall - Spray applied cellulose fiber. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. The minimum dry density shall be 4.30 lbs/ft^3.
INTERNATIONAL CELLULOSE CORP — Celbar-RL

5E. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 5) - Spray-applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. To facilitate the installation of the material, any thin, woven or non-woven netting may be attached by any means possible to the outer face the studs. The material shall reach equilibrium moisture content before the installation of materials on either face of the studs. The minimum dry density shall be 5.79 lbs/ft^3.
APPLEGATE HOLDINGS L L C — Applegate Advanced Stabilized Cellulose Insulation

6. **Steel Framing Members* —** (Optional, Not Shown) — Furring channels and Steel Framing Members as described below:

A. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Wallboard attached to furring channels as described in Item 2.

B. **Steel Framing Members* —** Used to attach furring channels (Item a) to studs (Item 1) . Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. Furring channels are friction fitted into clips. RSIC-1 clip for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) clip for use with 2-23/32 in. wide furring channels.

PAC INTERNATIONAL L L C — Types RSIC-1, RSIC-1 (2.75).

6A. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 6) — Furring channels and Steel Framing Members as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-3/8 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to studs. Clips spaced 48 in. OC. Genie clips secured to studs with No. 8 x 1-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
PLITEQ INC — Type Genie Clip

6B. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 6) — Furring channels and Steel Framing Members as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire. Gypsum board attached to furring channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Ba) to studs. Clips spaced 48 in. OC., and secured to studs with 2 in. coarse drywall screw with 1 in. diam washer through the center hole. Furring channels are friction fitted into clips.
STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237R

6C. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 6) — Furring channels and Steel Framing Members as described below:

A. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item 6Cb. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire. Gypsum board attached to furring channels as described in Item 2.

B. **Steel Framing Members* —** Used to attach furring channels (Item 6CA) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.
REGUPOL AMERICA — Type SonusClip

6D. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 6) — Resilient channels and Steel Framing Members as described below:

a. **Resilient Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC, and perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and secured in place with two No. 8 15 x 1/2 in. Philips Modified Truss screws spaced 2-1/2 in. from the center of the overlap. Gypsum board attached to resilient channels as described in Item 2.

b. **Steel Framing Members* —** Used to attach resilient channels (Item 6Da) to studs. Clips spaced 48 in. OC., and secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center hole. Resilient channels are secured to clips with one No. 10 x 1/2 in. pan-head self-drilling screw.
KEENE BUILDING PRODUCTS CO INC — Type RC+ Assurance Clip

6E. **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 6) — Used as an alternate method to attach resilient channels to wall studs. A resilient sound isolation accessory shall be used at each attachment point of the resilient channels and spaced max 24 in. O.C. Channel ends butted and centered under the structural members and attached with one accessory at each end. Additional accessories used to hold resilient channels that support the gypsum board end joints. The accessory envelops the mounting edge of the resilient channel. The accessory and resilient channel are fastened to the structural members with the screws supplied with the accessory and per the accessory manufacturer's installation instructions.
PAC INTERNATIONAL L L C — Type RC-1 Boost

6F **Steel Framing Members* —** (Optional, Not Shown, As an alternate to Item 6) — Furring channels and Steel Framing Members as described below:

a **Furring Channels —** Formed of No. 25 MSG galv steel. 2-23/32 in. wide by 7/8 in. or 1-1/2 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping #6 framing screws, min. 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Gypsum board attached to furring channels as described in Item 2.

b **Steel Framing Members* —** Used to attach furring channels (Item 6Fa) to studs. Clips spaced maximum 48 in. OC. Clips secured to studs with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. Furring channels are friction fitted into clips.

CLARKDIETRICH BUILDING SYSTEMS — Type ClarkDietrich Sound Clip

7. **Wall and Partition Facings and Accessories* —** (Optional, Not shown) — Nominal 1/2 in. thick, 4 ft wide panels, for optional use as an additional layer on one or both sides of the assembly. Panels attached in accordance with manufacturer's recommendations. When the QR-500 or QR-510 panel is installed between the wood framing and the UL Classified gypsum board, the required UL Classified gypsum board layer(s) is/are to be installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock QR-500 and QR-510

8. **Mineral and Fiber Board* —** ((Optional, Not Shown) — For optional use as an additional layer on one or both sides of wall. Nom 1/2 in. thick, 4 ft wide with long dimension parallel and centered over studs. Attached to framing as described in Item 2. The required UL Classified gypsum board layer(s) is/are to be installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
HOMASOTE CO — Homasote Type 440-32

9. **Non-Bearing Wall Partition Intersection —** (Optional) — Two nominal 2 by 4 in. stud or nominal 2 by 6 in. stud nailed together with two 3in. long 10d nails spaced a max. 16 in. OC. vertically and fastened to one side of the minimum 2 by 4 in. stud with 3 in. long 10d nails spaced a max 16 in. OC. vertically. Intersection between partition wood studs to be flush with the 2 by 4 in. studs. The wall partition wood studs are to be framed by with a second 2 by 4 in. wood stud fastened with 3 in. long 10d nails spaced a max. 16 in. OC. vertically. Maximum one non-bearing wall partition intersection per stud cavity. Non-bearing wall partition stud depth shall be at a minimum equal to the depth of the bearing wall.

(Optional, Not Shown) Alternate Construction For Use On One Side Of The Wall.

10. **Mineral and Fiber Board* —** For use with Items 10A-10D) —Nom 1/2 in. thick, 4 ft wide with long dimension parallel and centered over studs. Attached to framing with minimum 1-3/8 in. long ring shanked nails or 1-1/4 in. long Type W steel screws, spaced 12 in. OC along board edges and 24 in. OC in field of board along intermediate framing. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.
HOMASOTE CO — Homasote Type 440-32

10A. **Glass Fiber Insulation —** (For use with Item 10) — 3-1/2 in. thick glass fiber batts bearing the UL Classification Marking as to Surface Burning and/or Fire Resistance, placed to fill the interior of the wall. See Batts and Blankets (BKNV or BZJZ) categories for names of Classified companies.

10B. **Batts and Blankets* —** (As an alternate to Item 10B, For use with Item 10), 3 in. thick mineral wool batts, placed to fill interior of wall, attached to the 3-1/2 in. face of the studs with staples placed 24 in. OC.
THERMAFIBER INC — Type SAFB, SAFB FF

10C. **Adhesive —** (For use with Item 10) — Construction grade adhesive applied in vertical, serpentine, nominal 3/8 in. wide beads down the length of both vertical edges of Mineral and Fiber Board (Item 14A).

10D. **Gypsum Board* —** (For use with Item 10) — 5/8 in. thick, 4 ft wide, applied vertically over Mineral and Fiber Board (Item 14A) with vertical joints located anywhere over stud cavities. Secured to mineral and fiber boards with 1-1/2 in. Type G Screws spaced 8 in. OC along edges of each vertical joint and 12 in. OC in intermediate field of the Mineral and Fiber Board (Item 10). Secured to outermost studs and bearing plates with 2 in. long Type S screws spaced 8 in. OC. Gypsum Board joints covered with paper tape and joint compound. Screw heads covered with joint compound. Finish Rating 30 Min.
AMERICAN GYPSUM CO — Type AG-C

CERTAINTEED GYPSUM INC — Type C

CERTAINTEED GYPSUM INC — Type LGFC-C/A

GEORGIA-PACIFIC GYPSUM L L C — Types 5, DAPC, TG-C

NATIONAL GYPSUM CO — Types FSK-C, FSW-C

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type PG-C

PANEL REY S A — Type PRC

THAI GYPSUM PRODUCTS PCL — Type C

UNITED STATES GYPSUM CO — Type CTypes C, IP-X2, IPC-AR

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

The appearance of a company's name or product in this database does not in itself assure that products so identified have been manufactured under UL's Follow-Up Service. Only those products bearing the UL Mark should be considered to be Certified and covered under UL's Follow-Up Service. Always look for the Mark on the product.

UL DESIGN L521

BXUV.L521 - Fire-resistance Ratings - ANSI/UL 263

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. L521

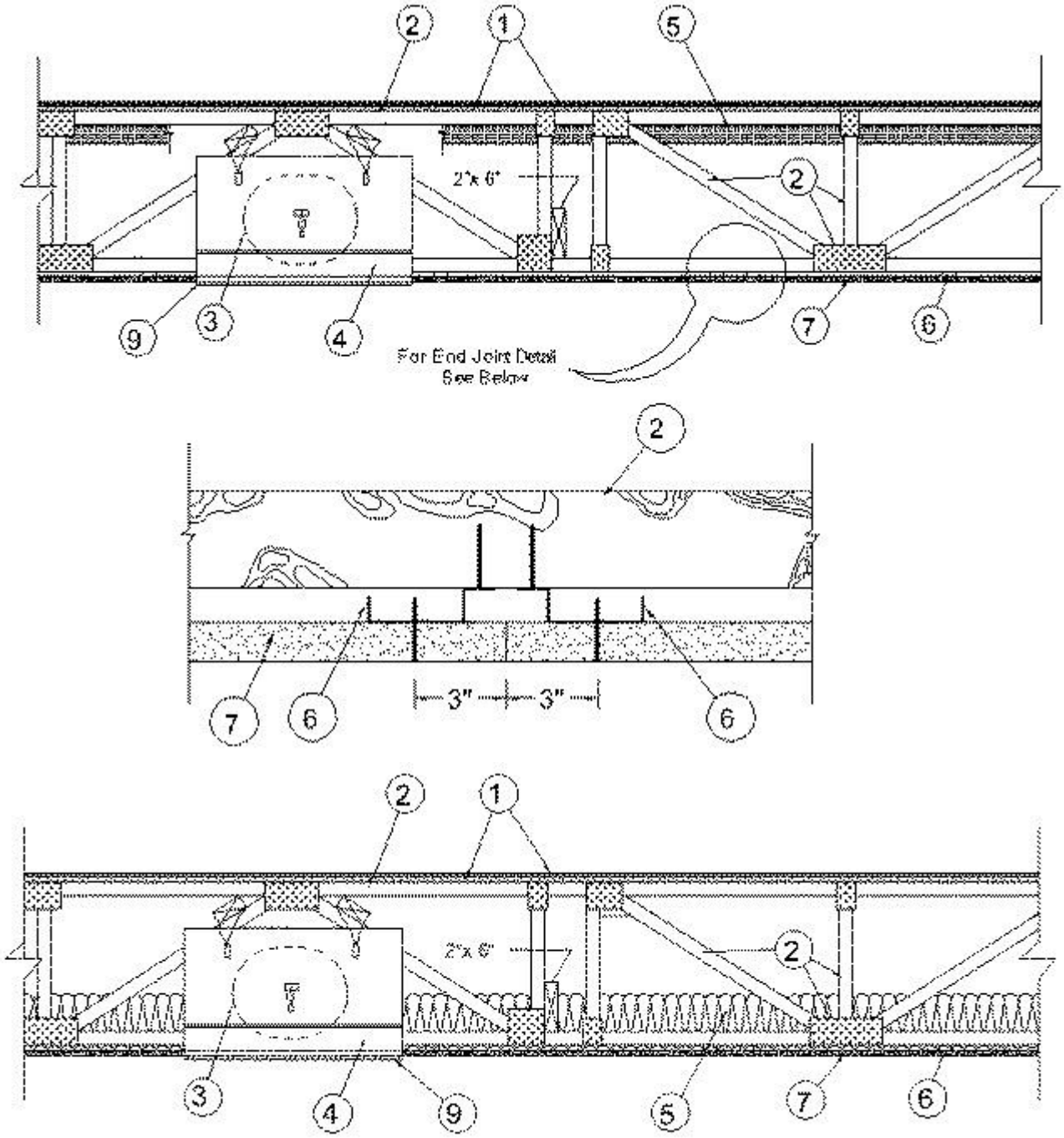
August 13, 2020

Unrestrained Assembly Rating — 1 Hr

Finish Rating — 25 Min (See Items 5 and 5A), 20 Min (See Items 6H and 7A)

This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.



Alternate Insulation Placement

1. **Flooring System —** The flooring system shall consist of one of the following:

System No. 1

Subflooring — Nom 23/32 in. thick wood structural panels installed perpendicular to trusses with end joints staggered. Plywood or panels secured to trusses with construction adhesive and No. 6d ringed shank nails, spaced 12 in. OC along each truss. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.

Vapor Barrier — (Optional) — Nom 0.030 in. thick commercial asphalt saturated felt.

Finish Floor — Min 1 by 4 in. T & G lumber installed perpendicular to trusses, or min 15/32 in. thick wood structural panels, min grade "Underlayment" or "Single-Floor". Face grain of plywood or strength axis of panel to be perpendicular to joists with joints staggered.

System No. 2

Subflooring — Nom 23/32 in. thick wood structural panels installed perpendicular to trusses with end joints staggered. Plywood or panels secured to trusses with construction adhesive and No. 6d ringed shank nails, spaced 12 in. OC along each truss. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.

Vapor Barrier — (Optional) — Nom 0.030 in. thick commercial asphalt saturated felt.

Finish Flooring* — Floor Topping Mixture — Min 3/4 in. thickness of floor topping mixture having a minimum compressive strength of 1800 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.

UNITED STATES GYPSUM CO — Types LRK, HSLRK, CSD

LATICRETE SUPERCAP L L C — Types LRK, HSLRK

USG MEXICO S A DE C V — Types LRK, HSLRK, CSD

Floor Mat Materials* — (Optional) — Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.

UNITED STATES GYPSUM CO — Types SAM, LEVELROCK® Brand Sound Reduction Board, LEVELROCK® Brand Floor Underlayment SRM-25

Alternate Floor Mat Materials* — (Optional) — Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding minimum thickness of floor topping over floor mat.
GRASSWORX L L C — SC Types

System No. 3 (For Use with Item 7A Only)

Finish Floor — Nom 23/32 in. thick wood structural panels installed perpendicular to trusses with end joints staggered. Plywood or panels secured to trusses with construction adhesive and 2-1/2 in. long nails, spaced 12 in. OC along each truss and 8 in. OC at the perimeter.

System No. 4

Structural Cement-Fiber Units* — Nom 3/4 in. thick, with long edges tongue and grooved. Long dimension of panels to be perpendicular to wood trusses with end joints staggered a min of 2 ft and centered over the trusses. Panels secured to wood trusses with 1-5/8 in. long, No. 8, self- countersinking wood screw spaced a max of 12 in. OC in the field with a screw located 1 in. and 2 in. from each edge, and 8 in. OC on the perimeter with a screw located 2 in. from each edge, located 1/2 in. from the end edges of the panel.
UNITED STATES GYPSUM CO — Types STRUCTO-CRETE, USGSP

Finish Flooring — Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture having a minimum compressive strength of 1800 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.
UNITED STATES GYPSUM CO — Types LRK, HSLRK, CSD

LATICRETE SUPERCAP L L C — Types LRK, HSLRK

USG MEXICO S A DE C V — Types LRK, HSLRK, CSD

Floor Mat Materials* — (Optional) — Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.
UNITED STATES GYPSUM CO — Types SAM, LEVELROCK® Brand Sound Reduction Board, LEVELROCK® Brand Floor Underlayment SRM-25

System No. 5

Structural Cement-Fiber Units* — Nom 3/4 in. thick, with long edges tongue and grooved. Long dimension of panels to be perpendicular to wood trusses with end joints staggered a min of 2 ft and centered over the trusses. Panels secured to wood trusses with 1-5/8 in. long, No. 8, self- countersinking wood screw spaced a max of 12 in. OC in the field with a screw located 1 in. and 2 in. from each edge, and 8 in. OC on the perimeter with a screw located 2 in. from each edge, located 1/2 in. from the end edges of the panel.
UNITED STATES GYPSUM CO — Types STRUCTO-CRETE, USGSP

System No. 6

Subflooring — Nom 23/32 in. thick wood structural panels installed perpendicular to trusses with end joints staggered. Plywood or panels secured to trusses with construction adhesive and No. 6d ringed shank nails, spaced 12 in. OC along each truss. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails. **Vapor Barrier —** (Optional) — Nom 0.030 in. thick commercial asphalt saturated felt. **Floor Mat Materials* —** (Optional) — Floor mat material nom 1/8 in. (3 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 3/4 in. (19 mm).
HACKER INDUSTRIES INC — FIRM-FILL SCM 125

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 1/4 in. (6 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1 in. (25 mm).
HACKER INDUSTRIES INC — Type FIRM-FILL SCM 250

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 3/8 in. (10 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1-1/4 in. (32 mm)
HACKER INDUSTRIES INC — FIRM-FILL SCM 400

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 3/4 in. (19 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1-1/2 in. (38 mm).
HACKER INDUSTRIES INC — Type FIRM-FILL SCM 750

Metal Lath (Optional) — (Optional) — For use with 3/8 in. (10 mm), or greater, floor mat materials, 3/8 in. expanded steel diamond mesh, 3.4 lbs/sq yd placed over the floor mat material. Hacker Floor Primer to be applied prior to the placement of the metal lath. When metal lath is used, floor topping thickness a nom 1 in. (25 mm) over the floor mat.**Finish Flooring — Floor Topping Mixture* —** Min 3/4 in. thickness of floor topping mixture having a min compressive strength of 1100 psi. Mixture shall consist of 6.8 gal of water to 80 lbs of floor topping mixture to 1.9 cu ft of sand.
HACKER INDUSTRIES INC — Firm-Fill Gypsum Concrete, Firm-Fill 2010, Firm-Fill 3310, Firm-Fill 4010, Gyp-Span Radiant

System No. 7

Subflooring — Nom 23/32 in. thick wood structural panels installed perpendicular to trusses with end joints staggered. Plywood or panels secured to trusses with construction adhesive and No. 6d ringed shank nails, spaced 12 in. OC along each truss. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.**Vapor Barrier —** (Optional) — Nom 0.030 in. thick commercial asphalt saturated felt.**Finish Floor* — Mineral and Fiber Board —** Min 1/2 in. thick, supplied in sizes ranging from 3 ft by 4 ft to 8 ft by 12 ft.
HOMASOTE CO — Type 440-32 Mineral and Fiber Board

System No. 8

Subflooring —Nom 23/32 in. thick wood structural panels installed perpendicular to trusses with end joints staggered. Plywood or panels secured to trusses with construction adhesive and No. 6d ringed shank nails, spaced 12 in. OC along each truss. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.

Vapor Barrier —(Optional) - Nom 0.030 in. thick commercial asphalt saturated felt.

Floor Mat Materials* — (Optional) — Floor mat material nom 5/64 in. (2 mm) thick adhered to subfloor with Hacker Floor Primer. Primer to be applied to the surface of the mat prior to the placement of floor-topping mixture. Floor topping thickness a min 1 in. over the floor mat.

HACKER INDUSTRIES INC — Type Hacker Sound-Mat

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 1/4 in. (6 mm) thick adhered to subfloor with Hacker Floor Primer. Primer to be applied to the surface of the mat prior to the placement of a min 1-1/4 in. (32 mm) of floor-topping mixture.

HACKER INDUSTRIES INC — Type Hacker Sound-Mat II

Metal Lath (Optional) — For use with 3/8 in. (10 mm) floor mat materials, 3/8 in. expanded steel diamond mesh, 3.4 lbs/sq yd placed over the floor mat material. Hacker Floor Primer to be applied prior to the placement of the metal lath. When metal lath is used, floor topping thickness a nom 1-1/4 in. over the floor mat.

Finish Flooring — Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture having a min compressive strength of 1100 psi. Mixture shall consist of 6.8 gal of water to 80 lbs of floor topping mixture to 1.9 cu ft of sand.

HACKER INDUSTRIES INC — Firm-Fill Gypsum Concrete, Firm-Fill High Strength, Gyp-Span Radiant

2. **Trusses —** Parallel chord trusses, spaced a max of 24 in. OC, fabricated from nom 2 by 4 lumber, with lumber oriented vertically or horizontally. Min truss depth is 12 in. when no **Ceiling Damper*** is used and 18 in. when a **Ceiling Damper*** is used. Truss members secured together with min 0.0356 in. thick galv steel plates. Plates have 5/16 in. long teeth projecting perpendicular to the plane of the plate. The teeth are in pairs facing each other (made by the same punch), forming a split tooth type plate. Each tooth has a chisel point on its outside edge. These points are diagonally opposite each other for each pair. The top half of each tooth has a twist for stiffness. The pairs are repeated on approx. 7/8 in. centers with four rows of teeth per inch of plate width.

3. **Air Duct* —** Any UL Class 0 or Class 1 flexible air duct installed in accordance with the instructions provided by the damper manufacturer.

4. **Ceiling Damper* —** For use with min 18 in. deep trusses. Max nom area shall be 324 sq in. with the length not to exceed 24 in. and the width not to exceed 20 in. Max height of damper shall be 14 in. Aggregate damper openings shall not exceed 162 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper. A steel grille (Item 9) shall be installed in accordance with installation instructions.
C&S AIR PRODUCTS — Model RD-521

POTTORFF — Model CFD-521

4A. **Alternate Ceiling Damper* —** For use with min 18 in. deep trusses. Max nom area shall be 196 sq in. with the length not to exceed 26 in. and the width not to exceed 14 in. Max height of damper shall be 7 in. Aggregate damper openings shall not exceed 98 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper. A steel grille (Item 9) not to exceed 144 $in.^2$ shall be installed in accordance with installation instructions.
C&S AIR PRODUCTS — Model RD-521-BT

POTTORFF — Model CFD-521-BT

4B. **Alternate Ceiling Damper* —** For use with min 18 in. deep trusses. Max nom area shall be 256 sq in. with the length not to exceed 24 in. and the width not to exceed 20 in. Max height of damper shall be 17 in. Aggregate damper openings shall not exceed 128 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper. A steel grille (Item 9) shall be installed in accordance with installation instructions.
C&S AIR PRODUCTS — Models RD-521-IP, RD-521-NP

POTTORFF — Models CFD-521-IP, CFD-521-NP

4C. **Alternate Ceiling Damper* —** For use with min 18 in. deep trusses. Max nom area shall be 144 sq in. with the length not to exceed 14 in. and the width not to exceed 12 in. Max height of damper shall be 17-7/8 in. Aggregate damper openings shall not exceed 74 sq in. per 100 sq ft of ceiling area. Damper installed in accordance with the manufacturers installation instructions provided with the damper. A steel grille (Item 9) shall be installed in accordance with installation instructions.
C&S AIR PRODUCTS — Models RD-521-90, RD-521-NP90

POTTORFF — Models CFD-521-90, CFD-521-90NP

4D. **Alternate Ceiling Damper* —** Ceiling damper & fan assembly for use with min 18 in. deep trusses. Max nom area shall be 75 sq in. with the length not to exceed 8-9/16 in. and the width not to exceed 8-3/4 in. Max height of damper shall be 9-7/8 in. Aggregate damper openings shall not exceed 38 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A plastic grille (Item 9) shall be installed in accordance with installation instructions.
DELTA ELECTRONICS INC — Models CRD2, GBR-CRD, ITG-CRD

4E. **Alternate Ceiling Damper* —** Ceiling damper & fan assembly for use with min 18 in. deep trusses. Max nom area shall be 75 sq in. with the length not to exceed 9-1/4 in. and the width not to exceed 9-3/4 in. Max height of damper shall be 9-7/8 in. Aggregate damper openings shall not exceed 45 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A plastic grille (Item 9) shall be installed in accordance with installation instructions.
DELTA ELECTRONICS INC — Model SIG-CRD

4F. **Alternate Ceiling Damper* —** Ceiling damper & fan assembly for use with min 18 in. deep trusses. Max nom area shall be 131 sq in. with the length not to exceed 11-1/16 in. and the width not to exceed 11-7/8 in. Aggregate damper openings shall not exceed 66 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A plastic grille (Item 9) shall be installed in accordance with installation instructions.
DELTA ELECTRONICS INC — Model SMT-CRD

4G. **Alternate Ceiling Damper* —** Ceiling damper & fan assembly for use with min 18 in. deep trusses. Max nom area shall be 103 sq in. with the length not to exceed 10-1/8 in. and the width not to exceed 10-1/8 in. Aggregate damper openings shall not exceed 52 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A plastic grille (Item 9) shall be installed in accordance with installation instructions.
PANASONIC CORPORATION, PANASONIC CORPORATION OF NORTH AMERICA — Model PC-RD05C5

4H. **Alternate Ceiling Damper* —** Ceiling damper & fan assembly for use with min 18 in. deep trusses. Max nom area shall be 113 sq in. with the length not to exceed 10-1/8 in. and the width not to exceed 11-1/8 in. Aggregate damper openings shall not exceed 57 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A plastic grille (Item 9) shall be installed in accordance with installation instructions.
BROAN-NUTONE L L C — Model RDFUWT

4I. **Alternate Ceiling Damper* —** Ceiling damper & fan assembly for use with min 18 in. deep trusses. Max nom area shall be 79 sq in. with the length not to exceed 10 in. and the width not to exceed 7-15/16 in. Aggregate damper openings shall not exceed 40 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A metallic grille (Item 9) shall be installed in accordance with installation instructions.
BROAN-NUTONE L L C — Models RDJ1 and RDH

4J. **Alternate Ceiling Damper* —** Ceiling damper & fan assembly for use with min 18 in. deep trusses. Max nom area shall be 87 sq in. with the length not to exceed 9 in. and the width not to exceed 9-11/16 in. Aggregate damper openings shall not exceed 44 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A plastic grille (Item 9) shall be installed in accordance with installation instructions.
BROAN-NUTONE L L C — Model RDMWT

4K. **Alternate Ceiling Damper* —** Ceiling damper & fan assembly for use with min 18 in. deep trusses. Max nom area shall be 87 sq in. with the length not to exceed 9 in. and the width not to exceed 9-11/16 in. Aggregate damper openings shall not exceed 44 sq in. per 100 sq ft of ceiling area. Damper shall be installed in combination with one of the fan models described in, and in accordance with, the manufacturer's installation instructions provided with the damper. A plastic grille (Item 9) shall be installed in accordance with installation instructions.
BROAN-NUTONE L L C — Model RDMWT2

5. **Batts and Blankets* —** (Optional) — Glass fiber or mineral wool insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance. When the resilient channels (Item 6) or furring channels (Item 6A) are spaced 24 in. OC, no insulation shall be installed in the concealed space. When the resilient channels (Item 6) or furring channels (Item 6A) are spaced 16 in. OC, the insulation shall be a max of 3-1/2 in. thick, and shall be secured against the subflooring with staples at 12 in. OC or held suspended in the concealed space with 0.090 in. diam galv steel wires attached to the wood trusses at 12 in. OC. When the resilient channels (Item 6) or furring channels (Item 6A) are spaced a max of 12 in. OC or when the Steel Framing Members (Item 6B) are used, there is no limit in the overall thickness of insulation, and the insulation can be secured against the subflooring, held suspended in the concealed space or draped over the resilient or furring channels (or Steel Framing Members) and gypsum panel membrane. When **Steel Framing Members** (Item 6C) are used, max 3-1/2 in. thick insulation shall be draped over the furring channels (Item 6Ca) and gypsum board ceiling membrane, and friction-fitted between trusses and Steel Framing Members (Item 6Cd). The finished rating has only been determined when the insulation is secured to the subflooring.

5A. **Fiber, Sprayed* —** (Dry Dense Packed 100% Borate Formulation) — (Optional) — As an alternate to Item 5, When used, the resilient channel and gypsum board attachment is modified as specified in Items 6 and 7 and wire mesh (Item 10) shall be attached to the furring channels to facilitate installation of the material. The finished rating when Fiber, Sprayed is used has not been determined. The fiber is applied without water or adhesive at a nominal dry density of 3.5 lb/ft^3, in accordance with the application instructions supplied with the product. When Item 5A (Fiber, Sprayed) is used, two layers of gypsum board required as described in Item 7. Not evaluated for use with Item 6B, 6C, 6G or 6H.
U S GREENFIBER L L C — INS735, INS745, INS750LD, INS765LD, INS773LD, & SANCTUARY to be used with dry application only.

5B. **Fiber, Sprayed* —** (Loose Fill 100% Borate Formulation) — (Optional) — As an alternate to Items 5 and 5A, The finished rating when Fiber, Sprayed is used has not been determined. The fiber is applied without water or adhesive at a minimum dry density of 0.5 lb/ft^3 and at a max thickness of 3-1/2 in., in accordance with the application instructions supplied with the product. Wire mesh (Item 10) shall be attached to the furring channels to facilitate installation of the material. When Item 5B (Fiber, Sprayed) is used, two layers of gypsum board required as described in Item 7. Not evaluated for use with Item 6B, 6C, 6D, 6E, 6F, 6G, 6H or 6I.
U S GREENFIBER L L C — INS735, INS745, INS750LD, INS765LD, INS773LD, & SANCTUARY to be used with dry application only.

5C. **Foamed Plastic* —** (As alternate to Item 5, 5A, or 5B, Not Shown) — Spray foam insulation applied directly to the underside of the plywood subflooring. Spray foam insulation installed to a maximum thickness of 10 in. at a nominal 0.5 lb/ft^3 density, while maintaining a minimum 8-1/2 in. clearance between the spray foam insulation and the gypsum board (Item 7). Spray foam insulation is limited for use with minimum 18 in. deep trusses (Item 2). When spray foam insulation is installed, resilient channels (Item 6) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board (Item 7) spaced maximum 3 in. away from gypsum butt joints. Gypsum board (Item 7) to be installed using minimum 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a fire damper (Items 4 through 4K) in the concealed space, minimum 1 in. clearance to be maintained between damper housing and spray foam insulation. Not evaluated for use with Items 5 through 5B, or 6A through 6I.
SES FOAM INC — Sucraseal

5D. **Cavity Insulation - Batts and Blankets* or Fiber, Sprayed* —** (As described above in Items 5 through 5B) — (For Use with Item 7A, Not Shown) — Min. 3-1/2 in thick with no limit on maximum thickness fitted in the concealed space, draped over the resilient channel (Item 6H)/gypsum board (Item 7A) ceiling membrane.

5E. **Foamed Plastic* —** (As alternate to Item 5, 5A, or 5C, Not Shown) — Spray foam insulation applied directly to the underside of the plywood subflooring. Spray foam insulation installed to a maximum thickness of 10 in. at a nominal 0.5 lb/ft^3 or 2.0 lb/ft^3 density, depending on the product installed. Spray foam insulation is limited to use with minimum 18 in. deep trusses (Item 2). When spray foam insulation is installed, resilient channels (Item 6) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board (Item 7) spaced maximum 3 in. away from gypsum butt joints. Gypsum board (Item 7) to be installed using minimum 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a fire damper (Items 4 through 4H) in the concealed space, minimum 1 in. clearance to be maintained between damper housing and spray foam insulation. Not evaluated for use with Items 5 through 5B, or 6A through 6I.
BASF CORP — Enertite® NM, Enertite® G, FE178®, Spraytite® 178, Spraytite® 81206, Walltite® 200, Walltite® US, Walltite® US-N, and Walltite® HP+

5F. **Foamed Plastic* —** — (As alternate to Item 5, 5A, 5B, 5C or 5E, Not Shown) — Spray foam insulation applied directly to the underside of the plywood subflooring. Spray foam insulation installed to a maximum thickness of 17 in. at a nominal 0.5 lb/ft^3 density, while maintaining a minimum 1-1/2 in. clearance between the spray foam insulation and the gypsum board (Item 7). Spray foam insulation is limited for use with minimum 18 in. deep trusses (Item 2). When spray foam insulation is installed, resilient channels (Item 6) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board (Item 7) spaced maximum 3 in. away from gypsum butt joints. Gypsum board (Item 7) to be installed using minimum 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a fire damper (Items 4 through 4K) in the concealed space, no clearance is necessary between damper housing and spray foam insulation. Not evaluated for use with Items 5 through 5B, or 6A through 6I.
SES FOAM INC — EasySeal.5

5G. **Foamed Plastic* —** (As alternate to Item 5 - not to be used in combination with any alternates to item 5) — Spray foam insulation applied directly to the underside of the plywood subflooring. Spray foam insulation installed to a maximum thickness of 11 in. at a nominal 1.0 lb/ft^3 - 2.5 lb/ft^3 density, while maintaining a minimum 7 in. clearance between the spray foam insulation and the gypsum board (Item 7). Spray foam insulation is limited for use with minimum 18 in. deep trusses (Item 2). When spray foam insulation is installed, resilient channels (Item 6) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board spaced maximum 3 in. away from gypsum butt joints. Gypsum board to be installed using minimum 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a fire damper (Items 4 through 4K) in the concealed space, no clearance is necessary between damper housing and spray foam insulation. Only for use with item 6 not evaluated for use with alternates to item 6.
CARLISLE SPRAY FOAM INSULATION — SealTite Pro Closed Cell (CC), SealTite Pro Open Cell (OC), SealTite Pro OCX, SealTite Pro No Trim, and SealTite Pro One Zero.

6. **Resilient Channels —** Formed from min 25 MSG galv steel installed perpendicular to trusses. When there is no insulation installed in the concealed space the resilient channels are spaced 24 in. OC. When insulation (Item 5) is secured to the underside of the subfloor the resilient channels are spaced 16 in. OC. When insulation, Items 5, 5A or 5B is applied over the resilient channel/gypsum panel ceiling membrane, or when Item 5C, 5E or 5F is applied to underside of subflooring, the resilient channels are spaced 12 in. OC. Channels secured to each truss with 1-1/4 in. long Type S bugle head steel screws. Channels overlapped 4 in. at splices. Two channels, spaced 6 in. OC, oriented opposite each gypsum panel end joint as shown in the above illustration. Additional channels shall extend min 6 in. beyond each side edge of panel.

6A. **Steel Framing Members* —** (Not Shown) — As an alternate to Item 6.

a. **Furring Channels —** Formed of No. 25 MSG galv steel, 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced 16 in. OC perpendicular to wood structural members. When insulation, Items 5, 5A or 5B is applied over the furring channel/gypsum panel ceiling membrane, the furring channel spacing shall be reduced to 12 in. OC. Channels secured to trusses as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galv steel wire near each end of overlap.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to trusses (Item 2). Clips spaced 48 in. OC. RSIC-1 and RSIC-1 (2.75) clips secured to alternating trusses with No. 8 x 2-1/2 in. course drywall screw through the center grommet. RSIC-V and RSIC-V (2.75) clips secured to alternating trusses with No. 8 x 1-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips. RSIC-1 and RSIC-V clips for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) and RSIC-V (2.75) clips for use with 2-23/32 in. wide furring channels. Adjoining channels are overlapped as described in Item a. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping No. 6 framing screws, min 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Additional clips required to hold furring channel that supports the gypsum board butt joints, as described in Item 7. When **Fiber, Sprayed** (Item 5B) is used, two layers of nom 5/8 in. thick, 4 ft wide gypsum board shall be installed as described in Item 7.
PAC INTERNATIONAL L L C — Types RSIC-1, RSIC-V, RSIC-1 (2.75), RSIC-V (2.75)

6B. **Steel Framing Members —** (Not Shown) — As an alternate to Item 6, main runners, cross tees, cross channels and wall angle as listed below.

a. **Main Runners —** Nom 10 or 12 ft long, 15/16 in. or 1-1/2 in. wide face, spaced 4 ft. OC. Main runners suspended by min 12 SWG galv steel hanger wires spaced 48 in. OC. Hanger wires to be located adjacent to main runner/cross tee intersections. Hanger wires wrapped and twist-tied on 16d nails driven in to side of trusses at least 5 in. above the bottom face.

b. **Cross Tees or Channels —** Nom 4 ft long cross tees, with 15/16 in. or 1-1/2 in. wide face, or nom 4 ft long cross channels, with 1-1/2 in. wide face, either spaced 16 in. OC, installed perpendicular to the main runners. Additional cross tees or channels used 8 in. from each side of butted gypsum board end joints. The cross tees or channels may be riveted or screw-attached to the wall angle or channel to facilitate the ceiling installation.

c. **Wall Angle or Channel —** Painted or galv steel angle with 1 in. legs or channel with 1 in. legs, 1-9/16 in. deep attached to walls at perimeter of ceiling with fasteners 16 in. OC. To support steel framing member ends and for screw-attachment of the gypsum panel.
CGC INC — Type DGL or RX

USG INTERIORS LLC — Type DGL or RX

6C. **Steel Framing Members* —** (Not Shown) — As an alternate to Item 6.

a. **Furring Channels —** Hat-shaped furring channels, 7/8 in. deep by 2-5/8 in. wide at the base and 1-1/4 in. wide at the face, formed from No. 25 ga. galv steel, spaced max. 16 in. OC perpendicular to trusses and Cold Rolled Channels (Item 6Cb). Furring channels secured to Cold Rolled Channels at every intersection with a 1/2 in. pan head self-drilling screw through each furring channel leg. Ends of adjoining channels overlapped 4 in. and tied together with two double

strand No. 18 SWG galv steel wire ties, one at each end of overlap. Supplemental furring channels at base layer and outer layer gypsum board butt joints are not required. Batts and Blankets draped over furring channels as described in Item 5. Two layers of gypsum board attached to furring channels as described in Item 7.

b. **Cold Rolled Channels —** 1-1/2 in. by 1/2 in., formed from No. 16 ga. galv steel, positioned vertically and parallel to trusses, friction-fitted into the channel caddy on the Steel Framing Members (Item 6Cd). Adjoining lengths of cold rolled channels lapped min. 6 in. and wire-tied together with two double strand 18 SWG galv steel wire ties, one at each end of overlap.

c. **Blocking —** Where truss design does not permit direct, full contact of the hanger bracket, a piece of nominal 2 by 4 in. lumber (blocking), min. 6 in. long to permit full contact of the hanger bracket, to be secured vertically to the side of the truss (Item 2) at the top and bottom of the blocking at each Steel Framing Member (Item 6Cd) location.

d. **Steel Framing Members* —** Hangers spaced 48 in. OC. max along truss, and secured to the Blocking (Item 6Cc) on alternating trusses with a single 5/16 in. by 2 in. hex head lag bolt or four #6 1-1/4 in. drywall screws through mounting hole(s) on the hanger bracket. The two 1/4 in. long steel teeth on the hanger are embedded in the side of the blocking. Hanger positioned on blocking and leveling bolt height adjusted such that furring channels are flush with bottom of trusses before gypsum board installation. Spring gauge of hanger chosen per manufacturer's instructions.
KINETICS NOISE CONTROL INC — Type ICW

6D. **Steel Framing Members* —** (Not Shown) — As an alternate to Item 6.

a. **Furring Channels —** Formed of No. 25 MSG galv steel, 2-3/8 in. wide by 7/8 in. deep, spaced 16 in. OC perpendicular to wood structural members. When insulation, Items 5 or 5A is applied over the furring channel/gypsum panel ceiling membrane, the furring channel spacing shall be reduced to 12 in. OC. Channels secured to trusses as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galv steel wire near each end of overlap.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to trusses (Item 2). Clips spaced 48 in. OC, and secured to the bottom chord of alternating trusses with two No. 8 x 2-1/2 in. course drywall screws, one through the hole at each end of the clip. When insulation, Items 5 or 5A is applied over the furring channel/gypsum panel ceiling membrane, the clip spacing shall be reduced to 24 in. OC and secured to consecutive trusses. Furring channels are friction fitted into clips. Adjoining channels are overlapped as described in Item a. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping No. 6 framing screws, min 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Additional clips required to hold furring channel that supports the gypsum board butt joints, as described in Item 7. Two layers of gypsum board required as described in Item 7. Not evaluated for use with Item 5B.
KINETICS NOISE CONTROL INC — Type Isomax

6E. **Steel Framing Members* —** (Not Shown) — As an alternate to Item 6.

a. **Furring Channels —** Formed of No. 25 MSG galv steel, 2-3/8 in. wide by 7/8 in. deep, spaced 16 in. OC perpendicular to wood structural members. When insulation, Items 5 or 5A is applied over the furring channel/gypsum panel ceiling membrane, the furring channel spacing shall be reduced to 12 in. OC. Channels secured to trusses as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire near each end of overlap.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to trusses (Item 2). Clips spaced 48 in. OC, and secured to the bottom chord of alternating trusses with one No. 8 x 2-1/2 in. coarse drywall screw through center grommet. When insulation, Items 5 or 5A is applied over the furring channel/gypsum panel ceiling membrane, the clip spacing shall be reduced to 24 in. OC and secured to consecutive trusses. Furring channels are friction fitted into clips. Adjoining channels are overlapped as described in Item a. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping No. 6 framing screws, min 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel. Additional clips required to hold furring channel that supports the gypsum board butt joints, as described in Item 7. Not evaluated for use with Item 5B.

PLITEQ INC — Type Genie Clip

6F. **Steel Framing Members* —** (Not Shown) — As an alternate to Items 6, furring channels and Steel Framing Members as described below.

a. **Furring Channels —** Formed of No. 25 MSG galv steel, 2-5/8 in. wide by 7/8 in deep, spaced 16 in OC, perpendicular to joists. When insulation, Items 5 or 5A is applied over the furring channel/gypsum panel ceiling membrane, the furring channel spacing shall be reduced to 12 in. OC. Channels secured to joists as described in Item b.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to the trusses (Item 2). Clips spaced at 48" OC and secured to the bottom of the joists with one 2 in. Coarse Drywall Screw with 1 in. diam washer through the center hole. Furring channels are then friction fitted into clips. Ends of channels are overlapped 6" and tied together with double strand of No. 18 AWG galvanized steel wire. Additional clips are required to hold furring channel that supports the gypsum board butt joints as described in Item 7.
STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237 or A237R

6G. **Steel Framing Members* —** (Not Shown) — As an alternate to Item 6 — Not for use with Items 5, 5A or 5B — Main runners nom 12 ft long, spaced 72 in. OC. Main runners suspended by min 12 SWG galv steel hanger wires spaced 48 in. OC. Cross tees, nom 6 ft long, installed perpendicular to main runners and spaced 24 in. OC. Additional 6 ft long cross tees required at each gypsum board end joint with butted gypsum board end joints centered between cross tees spaced 8 in. OC. The main runners and cross tees may be riveted or screw attached to the wall angle or channel to facilitate the ceiling installation.
USG INTERIORS LLC — Type DGL or RX

6H. **Resilient Channels —** For Use With Item 7A - Formed from min 25 MSG galv steel installed perpendicular to trusses and spaced 16 in. OC. Channels secured to each truss with 1-5/8 in. long Type S bugle head steel screws. Channels overlapped 4 in. at splices. Two channels, spaced 6 in. OC, oriented opposite each gypsum panel end joint. Additional channels shall extend min 6 in. beyond each side edge of panel. Insulation, Item 5D is applied over the resilient channel/gypsum panel ceiling membrane.

6I. **Steel Framing Members* —** (Not Shown) — As an alternate to Item 6, furring channels and Steel Framing Members as described below.

a. **Furring Channels —** Formed of No. 25 MSG galvanized steel, 2-1/2 in. wide by 7/8 in deep, spaced 16 in OC, perpendicular to trusses. When insulation, Items 5 or 5A is applied over the furring channel/gypsum panel ceiling membrane, the furring channel spacing shall be reduced to 12 in. OC. Channels secured to trusses as described in Item b.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Ia) to the trusses (Item 2). Clips spaced 48 in. OC on alternating trusses and secured to the bottom chord of the trusses with one 2-1/2 in. coarse drywall screw through the center grommet in accordance with the manufacturer's installation instructions. Furring channels are then friction fitted into clips. Ends of channels are overlapped 6 in. and tied together with double strand of No. 18 AWG galvanized steel wire. Additional clips are required to hold the furring channel that supports one end of the gypsum board butt joints as described in Item 7.
REGUPOL AMERICA — Type SonusClip

6J. **Steel Framing Members* —** (Not Shown) — Used to attach resilient channels (Item 6) to trusses (Item 2). Clips spaced 48 in. OC on adjacent trusses, and secured to trusses with one No. 8 x 2-1/2 in. coarse drywall screw through center grommet hole. Channels secured to clips with one #10 x 1/2 in. pan-head self-drilling screw. Ends of adjoining channels overlapped 6 in. and secured together with two #8 15 x 1/2 in. Philips Modified Truss screws spaced 2-1/2 in. from the center of the overlap. Gypsum board butt joints require additional resilient channels spaced 3 in. from the butt joint on either side. One edge of the extra channels will extend to an adjacent truss where it is secured with a clip.

KEENE BUILDING PRODUCTS CO INC — Type RC+ Assurance Clip

6K. **Steel Framing Members* —** (Not Shown) — As an alternate to Item 6. furring channels and Steel Framing Members as described below.

a. **Furring Channels —** Hat channels formed of No. 25 MSG galv steel, nom. 2-23/32 in. wide by 7/8 in. or 1-1/2 in. deep, When there is no insulation installed in the concealed space the resilient channels are spaced 24 in. OC. When insulation (Item 5) is secured to the underside of the subfloor the resilient channels are spaced 16 in. OC. When insulation, Items 5, 5A or 5B is applied over the resilient channel/gypsum panel ceiling membrane, or when Item 5C, 5E or 5F is applied to underside of subflooring, the resilient channels are spaced 12 in. OC. Channels secured to trusses as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 AWG galv steel wire near each end of overlap.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to trusses (Item 2). Clips spaced 48 in. OC with No. 8 x 2-1/2 in. course drywall screw through the center grommet. Furring channels are friction fitted into clips. Additional clips required to hold furring channel that supports the gypsum board butt joints, as described in Item 7.
CLARKDIETRICH BUILDING SYSTEMS — Type ClarkDietrich Sound Clip

6L. **Steel Framing Members* —** (Not Shown

a. **Furring Channels —** Formed of No. 25 MSG galv steel, nominal 2-1/2 in. wide by 7/8 in. deep, spaced as indicated in Item 6, perpendicular to the trusses. Channels secured to Cold Rolled Channels at every intersection with a 3/4 in. TEK screw through each furring channel leg. Ends of adjoining channels overlapped 12 in. and fastened together with two double strand No. 18 SWG galv steel wire ties, one at each end of overlap, or with two 3/4 in. TEK screws in each leg of the overlap section. Two furring channels used at end joints of gypsum board (Item 7), each extending a min of 6 in. beyond both side edges of the board.

b. **Cold Rolled Channels —** 1-1/2 in. by 1/2 in., formed from No. 16 ga. galv steel, positioned vertically and parallel to trusses, friction-fitted into the channel caddy on the Steel Framing Members (Item 6Ld) and secured with two 3/4 in. TEK screws. Adjoining lengths of cold rolled channels lapped min. 12 in. and secured along bottom legs with four 3/4 in. TEK screws and wire-tied together with two double strand 18 SWG galv steel wire ties, one at each end of overlap.

c. **Blocking —** Where truss design does not permit direct, full contact of the hanger bracket, a piece of nominal 2 by 4 in. lumber (blocking), min. 12 in. long to permit full contact of the hanger bracket, to be secured vertically to the side of the trusses at the top and bottom of the blocking at each Steel Framing Member (Item 6Ld) location with 16d nails or minimum 2-1/2 in. screws.

d. **Steel Framing Members* —** Spaced 48 in. OC. max along truss, and secured to the truss on alternating trusses with two, #10 x 1-1/2 in. screws through mounting holes on the hanger bracket.
PAC INTERNATIONAL L L C — Type RSIC-SI-CRC EZ Clip

6M. **Steel Framing Members* —** (Not Shown) — As an alternate to Item 6.

a. **Furring Channels —** Formed of No. 25 MSG galv steel, nominal 2-1/2 in. wide by 7/8 in. deep, spaced as indicated in Item 6, perpendicular to trusses and friction fit into Steel Framing Members (Item 6Mc). Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap or with two TEK screws along each leg of the 6 in. overlap. Two furring channels used at end joints of gypsum board (Item 7). Butt joint channels held in place by strong back channels placed upside down, on top of, and running perpendicular to primary furring channels, extending 6 in. longer than length of gypsum side joint. Strong back channels spaced maximum 48 in. OC. Strong back channels secured to every intersection of primary furring channels with four 7/16 in. pan head screws, two along each of the legs at intersections. Butt joint channels run perpendicular to strong back channels and shall be minimum 6 in. longer than length of joint, secured to strong back channels with 7/16 in. pan head screws, two along each of the legs at intersection with strong back channels.

b. **Blocking —** Where truss design does not permit direct, full contact of the hanger bracket, a piece of nominal 2 by 4 in. lumber (blocking), min. 12 in. long to permit full contact of the hanger bracket, to be secured vertically to the side of the trusses at the top and bottom of the blocking at each Steel Framing Member (Item 6c) location with 16d nails or minimum 2-1/2 in. screws.

c. **Steel Framing Members* —** Used to attach furring channels (Item 6La) to trusses. Clips spaced 48 in. OC and secured along truss webs at each furring channel intersection with min. 3/4 in. long self-drilling #10 x 1-1/2 in. screws through each of the provided hole locations. Furring channels are friction fitted into clips.
PAC INTERNATIONAL L L C — Type RSIC-S1-1 Ultra

6N. **Steel Framing Members* —** (Optional, Not Shown) — Used as an alternate method to attach resilient channels to structural members. A resilient sound isolation accessory shall be used at each attachment point of the resilient channels and spaced max 24 in. O.C. Channel ends butted and centered under the structural members and attached with one accessory at each end. Additional accessories used to hold resilient channels that support the gypsum board end joints. The accessory envelops the mounting edge of the resilient channel. The accessory and resilient channel are fastened to the structural members with the screws supplied with the accessory and per the accessory manufacturer's installation instructions. Gypsum Board butt joints staggered minimum 24 in. OC and Gypsum Board screws spaced 8 in. OC when used.
PAC INTERNATIONAL L L C — Types RC-1 Boost

7. **Gypsum Board* —** Nom 5/8 in. thick, 48 in. wide gypsum panels. When resilient channels (Item 6) are used, gypsum panels installed with long dimension perpendicular to resilient channels. Gypsum panels secured with 1 in. long Type S bugle head steel screws spaced 12 in. OC and located a min of 1/2 in. from side joints and 3 in. from the end joints. When insulation (Items 5 or 5A) is applied over the resilient channel/gypsum panel ceiling membrane screw spacing shall be reduced to 8 in. OC. When insulation (Item 5C, 5E or 5F) is applied to the underside of the subflooring, screw spacing shall be reduced to 8 in. OC and minimum 1-1/4 in. long Type S screws to install gypsum to the resilient channels (Item 6), and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. End joints secured to both resilient channels as shown in end joint detail. When **Steel Framing Members** (Item 6A) are used, gypsum panels installed with long dimensions perpendicular to furring channels. Panels attached to the furring channels using 1 in. long Type S bugle-head steel screws spaced 8 in. OC along butted end joints and in the field of the panel. Butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. Each end of each gypsum panel shall be supported by a single length of furring channel equal to the width of the gypsum panel plus 6 in. on each end. The two support furring channels shall be spaced approximately 3-1/2 in. OC, and be attached to underside of the truss with one clip at each end of the channel. When **Steel Framing Members*** (Item 6B) are used, gypsum panels installed with long dimension perpendicular to cross tees with side joints centered along main runners and end joints centered along cross tees. Panels fastened to cross tees with 1 in. long . Type S bugle-head screws spaced in the field and 8 in. OC along end joints. Panels fastened to main runners with 1 in. long . Type S bugle-head screws spaced midway between cross tees. Screws along sides and ends of panels spaced 3/8 to 1/2 in. from panel edge. End joints of panels shall be staggered with spacing between joints on adjacent panels not less than 4 2 ft OC. When **Fiber, Sprayed** (Items 5A or 5B) is used, two layers of nom 5/8 in. thick, 4 ft wide gypsum board are installed with long dimensions perpendicular to furring channels. Base layer gypsum board secured with 1 in. long Type S bugle head steel screws spaced 12 in. OC and located a min of 1/2 in. from side joints and 3 in. from the end joints. End joints secured to both resilient channels as shown in end joint detail. Outer layer gypsum board secured with 1-5/8 in. long Type S bugle head steel screws spaced 12 in. OC and located a min of 1/2 in. from side joints and 3 in. from the end joints. Outer layer shall be finished as described in Item 8. When both **Steel Framing Members** (Item 6A) and **Fiber, Sprayed** (Items 5A or 5B) are used, furring channels spaced 12 in. OC and two layers of nom 5/8 in. thick, 4 ft wide gypsum board are installed with long dimension perpendicular to furring channels. Base layer secured to furring channels with nom 1 in. long Type S bugle head screws spaced 8 in. OC along butted end joints and in the field of the board. Butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. Each end of each gypsum board shall be supported by a single length of furring channel equal to the width of the gypsum board plus 6 in. on each end. The two support furring channels shall be spaced approximately 3-1/2 in. OC, and be attached to the underside of the truss with one clip at each end of the channel. Outer layer secured to furring channels using 1-5/8 in. long Type S screws spaced 8 in. OC and 1-1/2 in. from the end joint. Butted end joints to be offset a min. of 8 in. from base layer end joints. Butted side joints of outer layer to be offset min. 18 in. from butted side joints of base layer. When **Steel Framing Members** (Item 6C) are used, two layers of nom 5/8 in. thick, 4 ft wide gypsum board are installed with long dimensions perpendicular to furring channels (Item 6Ca). Base layer attached to the furring channels using 1 in. long Type S bugle head

steel screws spaced 8 in. OC along butted end joints and 12 in. OC in the field of the board. Butted end joints centered on the continuous furring channels. Butted base layer end joints to be offset a min of 16 in. in adjacent courses. Outer layer attached to the furring channels using 1-5/8 in. long Type S bugle head steel screws spaced 8 in. OC at butted end joints and 12 in. OC in the field. Butted end joints centered on the continuous furring channels and offset a min of 16 in. from butted end joints of base layer. Butted side joints of outer layer to be offset min 16 in. from butted side joints of base layer. When **Steel Framing Members** (Item 6D) are used, two layers of nom 5/8 in. thick, 4 ft wide gypsum board are installed with long dimensions perpendicular to furring channels. Base layer attached to the furring channels using 1 in. long Type S bugle-head steel screws spaced 12 in. OC in the field of the board. Butted end joints shall be staggered min 2 ft. within the assembly, and occur midway between the continuous furring channels. Each end of each gypsum board shall be supported by a single length of furring channel equal to the width of the gypsum board plus 6 in. on each end. The two furring channels shall be spaced approximately 4 in. OC, and be attached to underside of the truss with one Isomax clip at each end of the channel. Screw spacing along the gypsum board butt joint shall be 8 in. OC. Outer layer attached to the furring channels using 1-5/8 in. long Type S bugle-head steel screws spaced 12 in. OC in the field. The end of the outer layer boards at the butt joint shall be attached to the base layer boards with 1-5/8 in. long Type G screws spaced 8 in. OC and 1-1/2 in. from the end joint. Butted end joints to be offset a min of 8 in. from base layer end joints. Butted side joints of outer layer to be offset min 18 in. from butted side joints of base layer. Outer layer shall be finished as described in Item 8. When **Steel Framing Members** (Item 6E) are used, one layer of nom 5/8 in. thick, 4 ft wide are installed with long dimensions perpendicular to furring channels. Gypsum board secured to furring channels using 1 in. long No. 6 Type S bugle-head steel screws spaced 12 in. OC in the field of the board. Butted end joints shall be staggered minimum 2 ft. within the assembly. Additional furring channels constructed as per Item 6E shall be used to support each end of each gypsum board. These additional furring channels shall be attached to underside of the truss with Genie clips as described in Item 6E. Screw spacing along the gypsum board butt joint shall be 8 in. OC. Outer layer attached to the furring channels using 1-5/8 in. long No. 6 Type S bugle-head steel screws spaced 12 in. OC in the field. The outer layer boards at the butt joint shall be attached to the base layer boards with No. 10, 1-1/2 in. long drywall screws spaced 8 in. OC and 1-1/2 in. from the end joint. Butted end joints to be offset a min of 24 in. from base layer end joints. Butted side joints of outer layer to be offset min 16 in. from butted side joints of base layer. When **Steel Framing Members** (Item 6F) are used, one layer of nom 5/8 in. thick, 4 ft wide gypsum board is installed with long dimensions perpendicular to furring channels. Gypsum board secured to furring channels with nom 1 in. long Type S bugle-head steel screws spaced 8 in. OC in the field of the board. Gypsum board butted end joints shall be staggered minimum 48 in. and centered over main furring channels. At the gypsum board butt joints, each end of each gypsum board shall be supported by a single length of furring channel equal to the width of the gypsum board plus 3 in. on each end. The two support furring channels shall be spaced approximately 3 in. in from joint. Screw spacing along the gypsum board butt joint and along both additional channels shall be 8 in. OC. Additional screws shall be placed in the adjacent section of gypsum board into the aforementioned 3 in. extension of the extra butt joint channels as well as into the main channel that runs between. Butt joint furring channels shall be attached with one RESILMOUNT Sound Isolation Clip at each end of the channel.

When alternate **Steel Framing Members*** (Item 6G) are used, gypsum board sheets installed with long dimension (side joints) perpendicular to the 6 ft long cross tees with the end joints staggered min 4 ft and centered between cross tees which are spaced 8 in. OC. Gypsum board side joints may occur beneath or between main runners. Prior to installation of the gypsum board sheets, backer strips consisting of nom 7-3/4 in. wide pieces of gypsum board are to be laid atop the cross tee flanges and centered over each butted end joint location. The backer strips are to be secured to the flanges of the cross tees at opposite corners of the backer strip with hold down clips to prevent the backer strips from being uplifted during screw-attachment of the gypsum board sheets. Gypsum board fastened to cross tees with 1 in. drywall screws spaced 1 in. and 4 in. from the side joints and max 8 in. OC in the field of the board. The butted end joints are to be secured to the backer strip with No. 10 by 1-1/2 in. long Type G laminating screws located 1 in. from each side of the butted end joint and spaced 1 in. and 4 in. from the side joints and max 8 in. OC in the field of the board.

When **Steel Framing Members** (Item 6I) are used, one layer of nom 5/8 in. thick, 4 ft wide gypsum board is installed with long dimensions perpendicular to furring channels. Gypsum board secured to furring channels with nom 1-1/4 in. long, fine thread, #6, Type S bugle-head steel screws spaced 8 in. OC along butt joints and in the field of the board. Gypsum board butted end joints shall be staggered minimum 24 in. and occur 3 in. from the continuous furring channels. At the gypsum board butt joints, an additional single length of furring channel shall be installed and be spaced approximately 3 in. from the butt joint (6 in. from the continuous furring channels) to support the floating end of the gypsum board. Each of these shorter sections of furring channel shall extend one truss beyond the width of the gypsum panel and be attached to the adjacent trusses with one SonusClip at every truss involved with the butt joint.

When **Steel Framing Members** (Item 6J) are used, one layer of nom 5/8 in. thick, 4 ft wide gypsum board is installed with long dimensions perpendicular to resilient channels. Gypsum board secured to resilient channels with nom 1 in. long Type S bugle-head steel screws spaced 8 in. OC in the field of the board and located 3/4 in. from side joints and 3 in. end joints. Gypsum board joints are to be staggered by a minimum of 24 in.

When **Steel Framing Members** (Item 6L) are used, nom 5/8 in. thick, 4 ft wide gypsum board, installed as described in Item 7. Adjacent butt joints staggered minimum 48 in. OC.

When **Steel Framing Members** (Item 6M) are used, nom 5/8 in. thick, 4 ft wide gypsum board, installed as described in Item 7. Butt joints staggered minimum 24 in. OC.

CGC INC — Types C, IP-X2, IPC-AR

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR

7A. **Gypsum Board* —** For use with Items 5D and 6H. Nom 5/8 in. thick, 48 in. wide gypsum panels installed with long dimension perpendicular to resilient channels. Gypsum panels secured with 1 in. long Type S bugle head steel screws spaced 8 in. OC and located a min of 1/2 in. from side joints and 3 in. from the end joints. Finish Rating with this ceiling system is 20 min.
CGC INC — Type ULIX

UNITED STATES GYPSUM CO — Type ULIX

8. **Finishing System —** (Not Shown) — Vinyl, dry or premixed joint compound, applied in two coats to joints and screw-heads. Nom 2 in. wide paper tape embedded in first layer of compound over all joints. As an alternate, nom 3/32 in. thick veneer plaster may be applied to the entire surface of gypsum board.

9. **Grille —** Grille installed in accordance with the installation instructions provided with the ceiling damper.

10. **Wire Mesh —** (Not Shown) — For use with Item 5A and 5B — 1 in. 20 gauge galvanized poultry netting installed between the furring channels and gypsum board. The poultry netting is attached with washers and 1/2 in. wafer head screws, spaced 24 in. OC., to the furring channels. The **Fiber, Sprayed** (Item 5A or 5B) is installed through cut-openings in the poultry netting, in-between trusses. The cut-openings in the poultry netting shall be staggered at a maximum of 6 ft.

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

Last Updated on 2020-08-13

UL DESIGN L598

BXUV.L598 - Fire-resistance Ratings - ANSI/UL 263

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

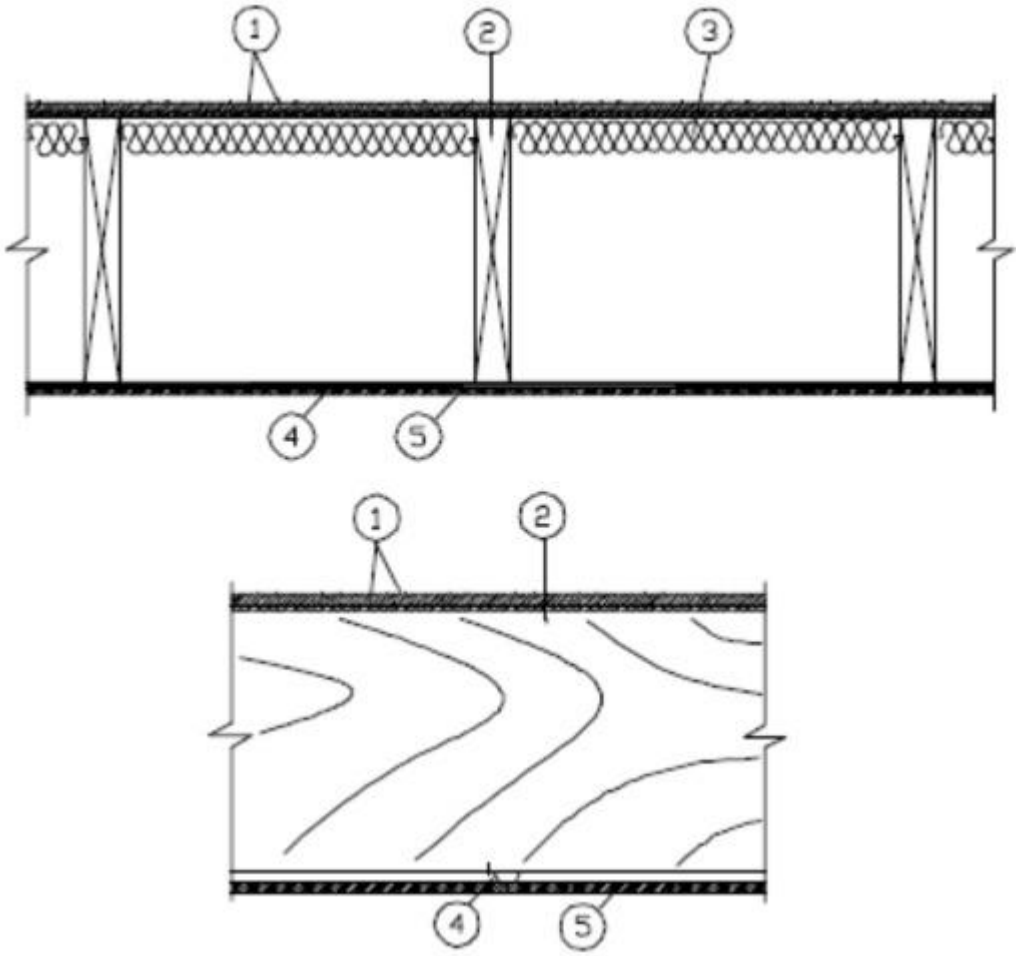
Design No. L598

May 08, 2020

Unrestrained Assembly Rating — 1 Hr.

This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



1. **Flooring System —** The flooring system shall consist of the following:
Subflooring — Nom 5/8 in. thick wood structural panels installed perpendicular to the joists with end joints staggered. Panels secured to joists with construction adhesive and No. 10d ringed shank nails, spaced 10 in. OC along each joist and 6 in. OC at the end joints.

System No. 1

Floor Mat Materials — (Optional) — Floor mat material nom 1/8 in. (3 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 3/4 in. (19 mm).

HACKER INDUSTRIES INC — FIRM-FILL SCM 125

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 1/4 in. (6 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1 in. (25 mm).

HACKER INDUSTRIES INC — Type FIRM-FILL SCM 250

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 3/8 in. (10 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1-1/4 in. (32 mm)

HACKER INDUSTRIES INC — FIRM-FILL SCM 400

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 3/4 in. (19 mm) thick loose laid over the subfloor. Floor topping thickness shall be a min of 1-1/2 in. (38 mm).

HACKER INDUSTRIES INC — Type FIRM-FILL SCM 750

Metal Lath (Optional) — For use with 3/8 in. (10 mm), or greater, floor mat materials, 3/8 in. expanded steel diamond mesh, 3.4 lbs/sq yd placed over the floor mat material. Hacker Floor Primer to be applied prior to the placement of the metal lath. When metal lath is used, floor topping thickness a nom 1 in. (25 mm) over the floor mat.

— **Finish Flooring — Floor Topping Mixture*** — Min 3/4 in. thickness of floor topping mixture having a min compressive strength of 1100 psi. Mixture shall consist of 6.8 gal of water to 80 lbs of floor topping mixture to 1.9 cu ft of sand.

HACKER INDUSTRIES INC — Firm-Fill Gypsum Concrete, Firm-Fill 2010, Firm-Fill 3310, Firm-Fill 4010, Gyp-Span Radiant

System No. 2

Floor Mat Materials* — (Optional) — Floor mat material nom 5/64 in. (2 mm) thick adhered to subfloor with Hacker Floor Primer. Primer to be applied to the surface of the mat prior to the placement of floor-topping mixture. Floor topping thickness a min 1 in. over the floor mat.

HACKER INDUSTRIES INC — Type Hacker Sound-Mat

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 1/4 in. (6 mm) thick adhered to subfloor with Hacker Floor Primer. Primer to be applied to the surface of the mat prior to the placement of a min 1-1/4 in. (32 mm) of floor-topping mixture.

HACKER INDUSTRIES INC — Type Hacker Sound-Mat II

Metal Lath (Optional) — For use with 3/8 in. (10 mm) floor mat materials, 3/8 in. expanded steel diamond mesh, 3.4 lbs/sq yd placed over the floor mat material. Hacker Floor Primer to be applied prior to the placement of the metal lath. When metal lath is used, floor topping thickness a nom 1-1/4 in. over the floor mat.

Finish Flooring — Floor Topping Mixture* — Min 3/4 in. thickness of floor topping mixture having a min compressive strength of 1100 psi. Mixture shall consist of 6.8 gal of water to 80 lbs of floor topping mixture to 1.9 cu ft of sand.

HACKER INDUSTRIES INC — Firm-Fill Gypsum Concrete, Firm-Fill High Strength, Gyp-Span Radiant

System No. 3

Finish Flooring - Floor Topping Mixture* — Min 3/4 in. thickness of any Floor Topping Mixture bearing the UL Classification Marking as to Fire Resistance. See Floor- and Roof-Topping Mixtures (CCOX) category for names of Classified Companies.

Vapor Barrier — (Optional) - Commercial asphalt saturated felt, 0.030 in. thick.

Vapor Barrier — (Optional) - Nom 0.010 in. thick commercial rosin-sized building paper.

Floor Mat Materials* — (Optional, Not Shown) - Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.
LOW & BONAR INC — EnkaSonic® by Colbond a member of the Low & Bonar group Types 125, 250, 250 Plus, 400, 400 Plus, 750 and 750 Plus.

Floor Mat Reinforcement — (Optional) - Refer to manufacturer's instructions regarding minimum thickness of floor topping for use with floor mat reinforcement.

Metal Lath — (Optional) — Expanded steel diamond mesh, 2.5 lb / sq yd loose laid over floor mat material.

Fiberglass Mesh Reinforcement — (Optional) — Coated non-woven glass fiber mesh grid loose laid over floor mat material.

2. **Wood Joists —** 2 by 10 in., spaced 16 in. OC.

3. **Batts and Blankets* —** Glass fiber or mineral wool insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance. Insulation shall be a max of 3-1/2 in. thick and shall be secured against the underside of the subflooring with staples at 12 in. OC.

4. **Resilient Channels —** Nom 1/2 in. deep by 2-3/8 in. wide at the base and 1-3/8 in. wide at the face, formed from 0.020 in. thick galv steel. Installed perpendicular to the wood joists, spaced a max of 16 in. OC. Channel splices overlapped 4 in. Channels secured to each truss with 1-1/4 in. long Type S screws.

4A. **Steel Framing Members* —** (Optional, Not Shown) — As an alternate to Item 4.

a. **Furring Channels —** Formed of No. 25 MSG galv steel, nominal 2-1/2 in. wide by 7/8 in. deep, spaced 16 in. OC, perpendicular to the joists. Channels secured to Cold Rolled Channels at every intersection with a 3/4 in. TEK screw through each furring channel leg. Ends of adjoining channels overlapped 12 in. and fastened together with two double strand No. 18 SWG galv steel wire ties, one at each end of overlap, or with two 3/4 in. TEK screws in each leg of the overlap section. Two furring channels positioned 3 in. OC, 1-1/2 in. on each side of gypsum board (Item 5) end joints, each extending a min of 6 in. beyond both side edges of the board.

b. **Cold Rolled Channels —** 1-1/2 in. by 1/2 in., formed from No. 16 ga. galv steel, positioned vertically and parallel to joists, friction-fitted into the channel caddy on the Steel Framing Members (Item 4Ac) and secured with two 3/4 in. TEK screws. Adjoining lengths of cold rolled channels lapped min. 12 in. and secured along bottom legs with four 3/4 in. TEK screws and wire-tied together with two double strand 18 SWG galv steel wire ties, one at each end of overlap.

c. **Steel Framing Members* —** Spaced 48 in. OC. max along joist, and secured to the joist on alternating joists with two, #10 x 1-1/2 in. screws through mounting holes on the hanger bracket.
PAC INTERNATIONAL L L C — Type RSIC-SI-CRC EZ Clip

4B. **Steel Framing Members* —** (Optional, Not Shown) — As an alternate to Item 4.

a. **Furring Channels —** Formed of No. 25 MSG galv steel, nominal 2-1/2 in. wide by 7/8 in. deep, spaced 16 in. OC perpendicular to joists and friction fit into Steel Framing Members (Item 4Bb). Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap or with two TEK screws along each leg of the 6 in. overlap. Two furring channels positioned 6 in. OC, 3 in. on each side of gypsum board (Item 5) end joints. Butt joint channels held in place by strong back channels placed upside down, on top of, and running perpendicular to primary furring channels, extending 6 in. longer than length of gypsum side joint. Strong back channels spaced maximum 48 in. OC. Strong back channels secured to every intersection of primary furring channels with four 7/16 in. pan head screws, two along each of the legs at intersections. Butt joint channels run perpendicular to strong back channels and shall be minimum 6 in. longer than length of joint, secured to strong back channels with 7/16 in. pan head screws, two along each of the legs at intersection with strong back channels.

b. **Steel Framing Members* —** Used to attach furring channels (Item 4Ba) to joists. Clips spaced 48 in. OC and secured along joist webs at each furring channel intersection with min. 3/4 in. long self-drilling #10 x 1-1/2 in. screws through each of the provided hole locations. Furring channels are friction fitted into clips.
PAC INTERNATIONAL L L C — Type RSIC-S1-1 Ultra

4C. **Steel Framing Members* —** (Not Shown) As an alternate to Item 4, furring channels and Steel Framing Members* as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel, 2-9/16 in. wide by 7/8 in. deep, spaced 16 in. OC perpendicular to joists. Channels secured to joists as described in Item b. Ends of adjoining channels overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap.

b. **Steel Framing Members* —** Used to attach furring channels (Item a) to joists (Item 2). Clips spaced 48 in. OC. RSIC-1 clips secured to joists with No. 8 x 2-1/2 in. coarse drywall screw through the center grommet. Furring channels are friction fitted into clips. RSIC-1 clips for use with 2-9/16 in. wide furring channels. Adjoining channels are overlapped as described in Item a. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping No. 6 framing screws, min 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel.
PAC INTERNATIONAL L L C — Type RSIC-1

5. **Gypsum Board* —** Nom 5/8 in. thick, 48 in. wide gypsum panels installed with long dimension perpendicular to resilient channels. Gypsum panels secured with 1 in. long Type S bugle head steel screws spaced 12 in. OC in the field and 6 in. OC along the butt joints. Screws located a min of 1/2 in. from side and end joints. Butted end joints shall be staggered min. 9 ft 4 in. within the assembly.
When **Steel Framing Members** (Item 4A) are used, nom 5/8 in. thick, 4 ft wide gypsum board, installed as described in Item 5. Adjacent butt joints staggered minimum 48 in. OC.

When **Steel Framing Members** (Item 4B) are used, nom 5/8 in. thick, 4 ft wide gypsum board, installed as described in Item 5. Butt joints staggered minimum 24 in. OC.

When **Steel Framing Members** (Item 4C) are used, gypsum panels installed with long dimensions perpendicular to furring channels. Panels attached to the furring channels using 1 in. long Type S bugle-head steel screws spaced 8 in. OC along butted end joints and in the field of the panel. Butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. Each end of each gypsum panel shall be supported by a single length of furring channel equal to the width of the gypsum panel plus 6 in. on each end. The two support furring channels shall be spaced approximately 3-1/2 in. OC, and be attached with one clip at each end of the channel.

AMERICAN GYPSUM CO — Type AG-C

CERTAINTEED GYPSUM INC — Type C.

GEORGIA-PACIFIC GYPSUM L L C — Types DAPC, TG-C

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type C.

5A. **Gypsum Board* —** (As an alternate to Item 5) - Nom 3/4 in. thick, 48 in. wide gypsum panels installed with long dimension perpendicular to resilient channels. Gypsum panels secured with 1-1/8 in. long Type S bugle head steel screws spaced 12 in. OC in the field and 6 in. OC along the butt joints. Screws located a min of 1/2 in. from side and end joints. Butted end joints shall be staggered min. 9 ft 4 in. within the assembly.
PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type PG-13.

6. **Finishing System —** (Not shown) - Vinyl, dry or premixed joint compound, applied in two coats to joints and screw-heads. Nom 2 in. wide paper tape embedded in first layer of compound over all joints.

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

Last Updated on 2020-05-08

UL DESIGN P531

BXUV.P531 - Fire-resistance Ratings - ANSI/UL 263

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. P531

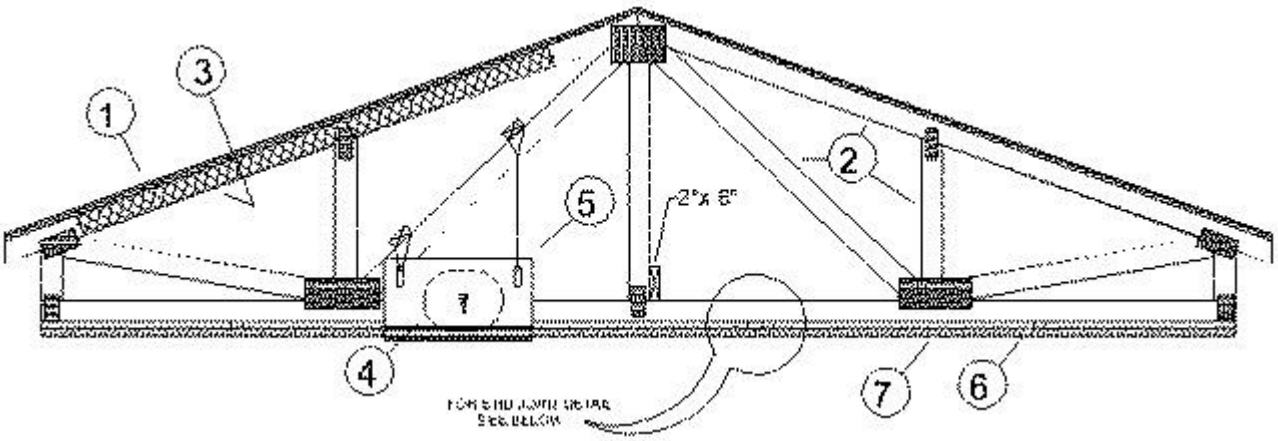
January 05, 2021

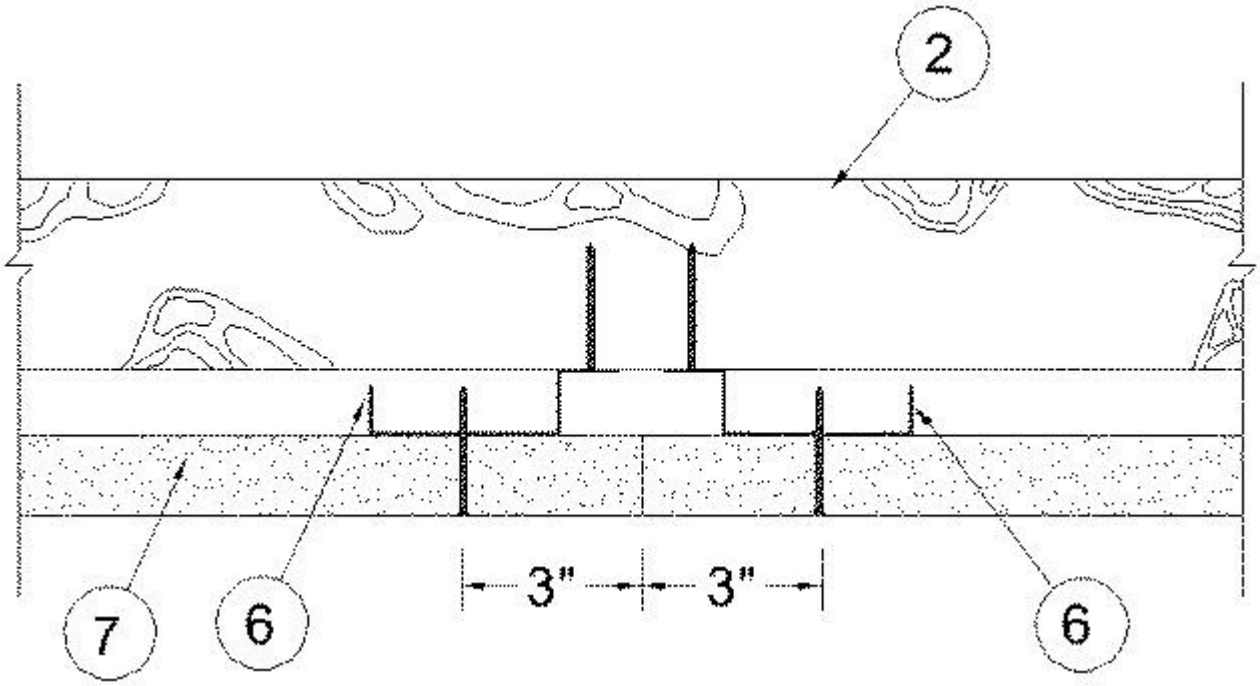
Unrestrained Assembly Rating - 1 Hr.

Finish Rating - 25 Min. (See Items 3 or 3A and 7), 20 Min. (See Items 3B and 7A)

This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide BXUV or BXUV7

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.





1. **Roofing System* —** Any UL Class A, B or C Roofing System **(TGFU)** or Prepared Roof Covering **(TFWZ)** acceptable for use over nom 15/32 in. thick wood structural panels, min. grade "C-D" or "Sheathing". Nom 15/32 in. thick wood structural panels secured to trusses with construction adhesive and No. 6d ringed shank nails. Nails spaced 12 in. OC along each truss. Staples having equal or greater withdrawal and lateral resistance strength may be substituted for the 6d nails.

2. **Trusses —** Pitch or Parallel chord trusses, spaced a max of 24 in. OC, fabricated from nom 2 by 4 lumber, with lumber oriented vertically or horizontally. Truss members secured together min.0.0356 in. thick galv steel plates. Plates have 5/16 in. long teeth projecting perpendicular to the plane of the plate. The teeth are in pairs facing each other (made by the same punch), forming a split tooth type plate. Each tooth has a chisel point on its outside edge. These points are diagonally opposite each other for each pair. The top half of each tooth has a twist for stiffness. The pairs are repeated on approximately 7/8 in. centers with four rows of teeth per inch of plate width. Where the truss intersects with the interior face of the exterior walls, the min truss depth shall be 5-1/4 in. with a min roof slope of 3/12 and a min. area in the plane of the truss of 21 sq/ft. Where the truss intersects with the interior face of the exterior walls, the min truss depth may be reduced to 3 in. if the batts and blankets (Item 3) are used as shown in the above illustration (Alternate Insulation Placement) and are firmly packed against the intersection of the bottom chords and the plywood sheathing.

3. **Batts and Blankets* —** (Optional) -Glass fiber insulation, secured to the wood structural panesl with staples spaced 12 in. OC or to the trusses with 0.090 in. diam galv steel wires spaced 12 in. OC. Any glass fiber insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance, having a min density of 0.5 pcf. As an option, the insulation may be fitted in the concealed space, draped over the resilient channel/gypsum wallboard ceiling membrane when resilient channels and gypsum wallboard attachment is modified as specified in Items 6 and 7. The finished rating has only been determined when the insulation is secured to the decking.

3A. **Cavity Insulation - Loose Fill Material* —** (Not Shown) As an alternate to Item 3 — Any thickness of loose fill material bearing the UL Classification Marking for Surface Burning Characteristics, having a min density of 0.5 pcf, fitted in the concealed space, draped over the resilient channel/gypsum wallboard ceiling membrane when resilient channels and gypsum wallboard attachment is modified as specified in Items 6 and 7. The finished rating when loose fill material is used has not been determined.

3B. **Cavity Insulation - Batts and Blankets* or Loose Fill Material* —** (Not Shown) (As described above in Items 3 and 3A) — For Use with Item 7A — Min. 3-1/2 in thick with no limit on maximum thickness fitted in the concealed space, draped over the resilient channel (Item 6A)/gypsum board (Item 7A) ceiling membrane.

3C. **Foamed Plastic* —** (As alternate to Item 3, 3A, 3B, Not Shown) — Spray foam insulation applied directly to the underside of the plywood roofing system (Item 1). Spray foam insulation installed to a maximum thickness of 10 in. at a nominal 0.5 lb/ft^3 or 2.0 lb/ft^3 density, depending on the product installed. When spray foam insulation is installed, resilient channels (Item 6) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board (Item 7) spaced maximum 3 in. away from gypsum butt joints. Gypsum board (Item 7) to be installed using minimum 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a fire damper (Item 5) in the concealed space, minimum 1 in. clearance to be maintained between damper housing and spray foam insulation. Not evaluated for use with Items 3 through 3B, 6A, 9, or 9A.
BASF CORP — Enertite® NM, Enertite® G, FE178®, Spraytite® 178, Spraytite® 81206, Walltite® 200, Walltite® US, Walltite® US-N, and Walltite® HP+

3C. **Fiber, Sprayed* —** As an alternate to Item 3 — Any thickness of spray-applied cellulose insulation material, having a min density of 0.5 lb/ft^3, applied with water, over the resilient channel/gypsum board ceiling membrane when resilient channels and gypsum board attachment is modified as specified in Items 6 and 7. Fiber, Sprayed is applied with moisture in accordance with the application instructions supplied with the product. The finish rating when Fiber Sprayed is used has not been determined. Alternate application method: The fiber is applied without water or adhesive in accordance with the application instructions supplied with a minimum density of 0.5 lb/ft^3 over the resilient channel/gypsum board ceiling membrane when resilient channels and gypsum board attachment is modified as specified in Items 6 and 7. Alternate application method: The fiber is applied without water or adhesive to a nominal density of 3.5 lb/ft^3 behind netting (Item 12) stapled to the rafters. The netting is stapled at both lower edges of the rafters creating a cavity to accept the cellulose fiber.
U S GREENFIBER L L C — INS735, INS745, INS750LD, and SANCTUARY for use with wet or dry applications. INS515LD, INS541LD, INS765LD for dry application only.

3D. **Foamed Plastic* —** (As alternate to Items 3, 3A, 3B, or 3C Not Shown) — Spray foam insulation applied directly to the underside of the roofing system (Item 1). Spray foam insulation installed to a maximum thickness of 10 in. at a nominal 0.5 lb/ft^3 or 2.0 lb/ft^3 density, depending on the product installed. When spray foam insulation is installed, resilient channels (Item 6) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board (Item 7) spaced maximum 3 in. away from gypsum butt joints. Gypsum board (Item 7) to be installed using minimum 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered min. 2 ft within the assembly, and occur midway between the continuous furring channels. If used with a fire damper (Item 5) in the concealed space, minimum 1 in. clearance to be maintained between damper housing and spray foam insulation. Not evaluated for use with Item 6A.
BASF CORP — Enertite® NM, FE178®, Spraytite® 178, Spraytite® 81206

SES FOAM INC — Sucraseal

3E. **Foamed Plastic* —** (As alternate to Item 3 - not to be used in combination with any alternates to item 3) — Spray foam insulation applied directly to the underside of the underside of the roofing system. Spray foam insulation installed to a maximum thickness of 11 in. at a nominal 1.0 lb/ft^3 - 2.5 lb/ft^3 density, while maintaining a minimum 7 in. clearance between the spray foam insulation and the gypsum board (Item 7). Spray foam insulation is limited for use with minimum 18 in. deep trusses (Item 2). When spray foam insulation is installed, resilient channels (Item 6) shall be installed maximum 12 in. OC, with channels adjacent to butt joints of gypsum board spaced maximum 3 in. away from gypsum butt joints. Gypsum board to be installed using minimum 1-1/4 in. long Type S screws, spaced maximum 8 in. OC, and butted end joints shall be staggered

min. 2 ft within the assembly, and occur midway between the continuous furring channels, as illustrated above. If used with a ceiling damper (Items 5) in the concealed space, no clearance is necessary between damper housing and spray foam insulation. Only for use with item 5 not evaluated for use with alternates to item 5.
CARLISLE SPRAY FOAM INSULATION — SealTite Pro Closed Cell (CC), SealTite Pro Open Cell (OC), SealTite Pro OCX, SealTite Pro No Trim, and SealTite Pro One Zero.

4. **Air Duct* —** Any UL Class 0 or Class 1 flexible air duct installed in accordance with the instructions provided by the damper manufacturer.

5. **Damper* —** Max nom 20 in. long by 18 in. wide by 2-1/8 in. high, fabricated from galvanized steel. Plenum box maximum size nom. 21 in. long by 18 in. wide by 16 in. high fabricated from either galavanized steel or Classified Air Duct Materials bearing the UL Class 0 or Class 1 rigid air duct material. Installed in accordance with the instructions provided by the manufacturer. Max damper openings not to exceed 180 sq in. per 100 sq ft of ceiling area.
NAILOR INDUSTRIES INC — Types 0755, 0755A, 0756, 0756D, 0757 , 0757D, 0757FP, 0757DFP, 0758, 0759, 0760, 0761, 0762, 0763, CRD5, CRD5D, CRD6, CRD6D, CRD6FP, CRD6DFP.

SAFE AIR DOWCO — 0455, 0455A, 0456, 0456D, 0457, 0457D, 0457-DB, 0457-CB, 0463-FB, 0457-EB, 0463-GB, 0463

6. **Resilient Channels —** Resilient channels formed of 25 MSG thick galv steel, spaced 16 in. OC, installed perpendicular to trusses. When batt and blanket material, Item 3, is draped over the resilient channel/gypsum wallboard ceiling membrane, or when insulation (Item 3C) is applied to the underside of the roofing system (Item 1), the spacing shall be 12 in. OC. Channels secured to each truss with 1-1/4 in. long Type S steel screws. Channels overlapped 4 in. at splices. Channels oriented opposite at wallboard butt joints (spaced 6 in. OC) as shown in the above illustration.

6A. **Resilient Channels - (Not Shown) —** For Use With Item 7A - Formed from min 25 MSG galv steel installed perpendicular to trusses and spaced 16 in. OC. Channels secured to each truss with 1-5/8 in. long Type S bugle head steel screws. Channels overlapped 4 in. at splices. Two channels, spaced 6 in. OC, oriented opposite each gypsum panel end joint. Additional channels shall extend min 6 in. beyond each side edge of panel. Insulation, Item 3B is applied over the resilient channel/gypsum panel (Item 7A) ceiling membrane.

7. **Gypsum Board* —** Nom 5/8 in. thick, 48 in. wide, installed with long dimension perpendicular to resilient channels with 1 in. long Type S screws spaced 12 in. OC and located a min of 1/2 in. from side joints and 3 in. from the end joints. At end joints, two resilient channels are used, extending a min of 6 in. beyond both ends of the joint. When batt and blanket insulation, Item 3, is draped over the resilient channel/gypsum wallboard ceiling membrane, screws shall be installed at 8 in. OC. When insulation (Item 3C) is installed in the concealed space, spray-applied to the underside of the roofing system (Item 1), screws are spaced a max of 8 in. OC along resilient channels, fasteners are increased in length to 1-1/4 in, and gypsum board butt joints shall be staggered min. 2 ft within the assembly, and occur between the main furring channels.
CGC INC — Types C, IP-X2, IPC-AR

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR

USG BORAL DRYWALL SFZ LLC — Type C

7A. **Gypsum Board* - (Not Shown) —** For use with Items 3B and 6A. Nom 5/8 in. thick, 48 in. wide gypsum panels installed with long dimension perpendicular to resilient channels. Gypsum panels secured with 1 in. long Type S bugle head steel screws spaced 8 in. OC and located a min of 1/2 in. from side joints and 3 in. from the end joints. Finish Rating with this ceiling system is 20 min.
CGC INC — Type ULIX

UNITED STATES GYPSUM CO — Type ULIX

8. **Finishing System —** (Not Shown)— Vinyl, dry or premixed joint compound, applied in two coats to joints and screw-heads; paper tape, 2 in. wide, embedded in first layer of compound over all joints. As an alternate, nom 3/32 in. thick veneer plaster may be applied to the entire surface of gypsum wallboard.

9. **Steel Framing Members —** (Optional) (Not Shown) In lieu of Item 6.

a. **Main runners —** Installed perpendicular to trusses - Nom 12 ft long, 15/16 in. or 1-1/2 in. wide face, spaced 4 ft OC. Main runners hung a min of 2 in. from bottom chord of trusses with 12 SWG galv steel wire. Wires located a max of 48 in. OC.

b. **Cross tees or channels —** Nom 4 ft long, 15/16 in. or 1-1/2 in. wide face or cross channels, nom 4 ft long, 1-1/2 wide face, installed perpendicular to the main runners, spaced 16 in. OC. Additional cross tees or channels used at 8 in. from each side of butted wallboard end joints. The cross tees or channels may be riveted or screw-attached to the wall angle or channel to facilitate the ceiling installation.

c. **Wall angles or channels —** Used to support steel framing member ends and for screw-attachment of the gypsum wallboard - Painted or galv steel angles with 1 in. legs or channels with 1 in. legs and 1-9/16 in. deep, attached to walls at perimeter of ceiling with fasteners 16 in. OC.

CGC INC — Type DGL or RX.

USG INTERIORS LLC — Type DGL or RX.

9A. **Alternate Steel Framing Members* —** (Not Shown) - As an alternate to Item 9 - Not for use with Items 3 or 3A - Main runners nom 12 ft long, spaced 72 in. OC. Main runners suspended by min 12 SWG galv steel hanger wires spaced 48 in. OC. Cross tees, nom 6 ft long, installed perpendicular to main runners and spaced 24 in. OC. Additional 6 ft long cross tees required at each gypsum board end joint with butted gypsum board end joints centered between cross tees spaced 8 in. OC. The main runners and cross tees may be riveted or screw attached to the wall angle or channel to facilitate the ceiling installation.

USG INTERIORS LLC — Type DGL or RX

10. **Gypsum Board* —** For use with **Steel Framing Members*** (Item 9) when **Batts and Blankets*** (Item 3) are not used- One layer of nom 5/8 in. thick by 48 in. wide boards, installed with long dimension parallel to the main runners. Wallboard fastened to each cross tee or channel with five wallboard screws, with one screw located at the midspan of the cross tee or channel, one screw located 12 in. from and on each side of the cross tee or channel mid span and one screw located 1-1/2 in. from each wallboard side joint. Except at wallboard end joints, wallboard screws shall be located on alternating sides of cross tee flange. At wallboard end joints, wallboard screws shall be located 1/2 in. from the joint. Wallboard fastened to main runners with wallboard screws 1/2 in. from side joints, midway between intersections with cross tees or channels (16 in. OC). End joints of adjacent wallboard sheets shall be staggered not less than 32 in. Wallboard sheets screw attached to leg of wall angle with wallboard screws spaced 12 in. OC. Joints treated as described in Item 7. For use with **Steel Framing Members*** (Item 9) when **Batts and Blankets*** (Item 3) are used - Ratings limited to 1 Hour - 5/8 in. thick, 4 ft wide; installed with long dimension perpendicular to cross tees with side joints centered along main runners and end joints centered along cross tees. Fastened to cross tees with 1 in. long steel wallboard screws spaced 8 in. OC in the field and 8 in. OC along end joints. Fastened to main runners with 1 in. long wallboard screws spaced midway between cross tees. Screws along sides and ends of boards spaced 3/8 to 1/2 in. from board edge. End joints of the sheets shall be staggered with spacing between joints on adjacent boards not less than 4 ft OC.

CGC INC — Types C, IP-X2, IPC-AR.

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR.

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR.

11. **Gypsum Board* —** For use with **Steel Framing Members*** (Item 9A) - One layer of nom 5/8 in. thick by 48 in. wide boards, installed with long dimension (side joints) perpendicular to the 6 ft long cross tees with the end joints staggered min 4 ft and centered between cross tees which are spaced 8 in. OC. Gypsum board side joints may occur beneath or between main runners. Prior to installation of the gypsum board sheets, backer strips consisting of nom 7-3/4 in. wide pieces of gypsum board are to be laid atop the cross tee flanges and centered over each butted end joint location. The backer strips are to be secured to the flanges of the cross tees at opposite corners of the backer strip with hold down clips to prevent the backer strips from being uplifted during screw-attachment of the gypsum board sheets. Gypsum board fastened to cross tees with 1 in. drywall screws spaced 1 in. and 4 in. from the side joints and max 8 in. OC in the field of the board. The butted end joints are to be secured to the backer strip with No. 10 by 1-1/2 in. long Type G laminating screws located 1 in. from each side of the butted end joint and spaced 1 in. and 4 in. from the side joints and max 8 in. OC in the field of the board.
CGC INC — Types C, IP-X2, IPC-AR.

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR.

USG BORAL DRYWALL SFZ LLC — Type C

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR.

12. **Netting —** (Not Shown) Fibrous, woven netting material fastened to underside of each joist with staples, with side joints overlapped.

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

Last Updated on 2021-01-05

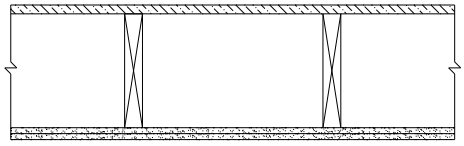
GA File No. RC 2601

ROOF-CEILING SYSTEMS

GA FILE NO. RC 2601 | **GENERIC** | **1 HOUR FIRE**

GYPSUM WALLBOARD, WOOD JOISTS, ROOF COVERING

Base layer 5/8" type X gypsum wallboard applied at right angles to 2 X 10 wood joists 24" o.c. with 1 1/4" Type W or S drywall screws 24" o.c. **Face** layer 5/8" type X gypsum wallboard or gypsum veneer base applied at right angles to joists with 1 7/8" Type W or S drywall screws 12" o.c. at joints and intermediate joists and 1 1/2" Type G drywall screws 12" o.c. placed 2" back on either side of end joints. Joints offset 24" from base layer joints. Wood joists supporting 1/2" plywood with exterior glue applied at right angles to joists with 8d nails. Appropriate roof covering. **Ceiling provides one hour fire resistance protection for wood framing, including trusses.**



Approx. Ceiling Weight: 5 psf

Fire Test: FM FC 172, 2-25-72; ITS, 8-6-98

UL DESIGN HW-D-0088

ONLINE CERTIFICATIONS DIRECTORY

System No. HW-D-0088
XHBN.HW-D-0088
Joint Systems

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Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

XHBN - Joint Systems

XHBN7 - Joint Systems Certified for Canada

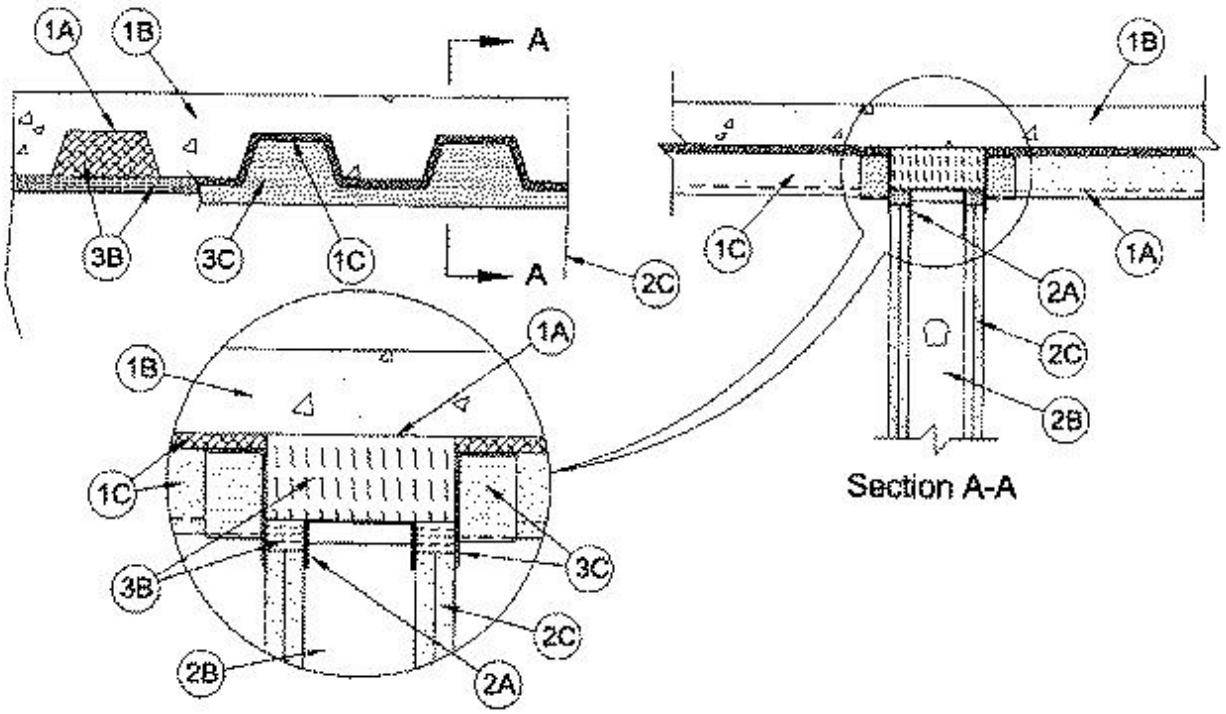
See General Information for Joint Systems

See General Information for Joint Systems Certified for Canada

System No. HW-D-0088

September 01, 2016

ANSI/UL2079	CAN/ULC S115
Assembly Rating — 1 and 2 Hr (See Item 2)	F Rating — 1 and 2 Hr (See Item 2)
Nominal Joint Width — 1 In.	FT Rating — 1 and 2 Hr (See Item 2)
Class II or III Movement Capabilities — 19% Compression or Extension	FH Rating — 1 and 2 Hr (See Item 2)
L Rating At Ambient — Less Than 1 CFM/lin ft	FTH Rating — 1 and 2 Hr (See Item 2)
L Rating At 400 F — Less Than 1 CFM/lin ft	Nominal Joint Width — 25 mm
	Class II or III Movement Capabilities — 19% Compression or Extension
	L Rating At Ambient — Less Than 1 CFM/lin ft
	L Rating At 400 F — Less Than 1 CFM/lin ft



1. **Floor Assembly —** The fire-rated fluted steel deck/concrete floor assembly shall be constructed of the materials and in the manner described in the individual D700 or D800 Series Floor-Ceiling Design in the UL Fire Resistance Directory and shall include the following construction features:

A. **Steel Floor and Form Units* —** Max 3 in. (76 mm) deep galv steel fluted floor units.

B. **Concrete —** Min 2-1/2 in. (64 mm) thick reinforced concrete, as measured from the top plane of the floor units.

C. **Spray-Applied Fire Resistive Material* —** After installation of the ceiling runner (Item 2A) or deflection track (Item 3A, if used), steel floor units to be sprayed with a min 5/16 in. (8 mm) to max 11/16 in. (18 mm) thickness of material in accordance with the specifications in the individual D700 or D800 Series Design. Material is to be excluded from the steel deck in the area immediately above the wall as well as from the flanges of the ceiling runner or deflection track.

ISOLATEK INTERNATIONAL — Type 300, Type II

GCP APPLIED TECHNOLOGIES INC — Type MK-6/HY

1A. **Roof Assembly —** (Not Shown) — As an alternate to the floor assembly (Item 1), a fire rated fluted steel deck roof assembly may be used. The roof assembly shall be constructed of the materials and in the manner described in the individual P700 or P800 Series Roof-Ceiling Design in the UL Fire Resistance Directory. The hourly fire rating of the roof assembly shall be equal to or greater than the hourly fire rating of the wall assembly. The roof assembly shall include the following construction features:

A. **Steel Roof Deck —** Max 3 in. (76 mm) deep galv steel fluted roof deck.

B. **Roof Insulation — Mineral and Fiber Board* —** Min 3/4 in. (19 mm) thick boards applied in one or more layers directly over steel roof deck or over gypsum board sheathing laid atop steel roof deck.

C. **Roof Covering* —** Hot-mopped or cold-application materials compatible with mineral and fiber board insulation.

D. **Spray-Applied Fire Resistive Material* —** After installation of the ceiling runner (Item 2A) or deflection track (Item 3A, if used), steel roof deck to be sprayed with a max 3/4 in. (19 mm) thickness of spray applied fire resistive material as specified in the individual P700 or P800 Series Roof-Ceiling design. Material is to be excluded from the steel deck in the area immediately above the wall as well as from the flanges of the ceiling runner or deflection track.

ISOLATEK INTERNATIONAL — Type 300, Type II

GCP APPLIED TECHNOLOGIES INC — Type MK-6/HY

2. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum board/stud wall assembly shall be constructed of the materials and in the manner described in the individual U400 or V400 Series Wall and Partition Design in the UL Fire Resistance Directory and shall include the following construction features:

A. **Steel Floor and Ceiling Runners —** Floor and ceiling runners of wall assembly shall consist of galv steel channels sized to accommodate steel studs . Ceiling runner to be provided with min 1-1/4 in. (32 mm) to max 2 in. (51 mm) flanges. When deflection channel (Item 3A) is used, flange height of ceiling runner is to be equal to or greater than flange height of deflection channel and the ceiling runner is to nest within the deflection channel with a 1/2 in. (13 mm) to 3/4 in. (19 mm) gap maintained between the top of the ceiling runner and the top of the deflection channel. When deflection channel is not used, ceiling runner installed perpendicular to direction of fluted steel deck prior to the application of spray-applied fire resistive material and secured to valleys with steel masonry anchors or welds spaced max 24 in. (610 mm) OC.

A1. **Light Gauge Framing* — Slotted Ceiling Runner —** As an alternate to the ceiling runner in Item 2A, ceiling runner to consist of galv steel channel with slotted flanges sized to accommodate steel studs (Items 2B). Slotted ceiling runner installed perpendicular to direction of fluted steel deck prior to the application of spray-applied fire resistive material and secured to valleys with steel masonry anchors spaced max 24 in. (610 mm) OC. When slotted ceiling runner is used, deflection channel (Item 3A) shall not be used.

BRADY CONSTRUCTION INNOVATIONS INC, DBA SLIPTRACK SYSTEMS — SLP-TRK

CALIFORNIA EXPANDED METAL PRODUCTS CO — CST

CLARKDIETRICH BUILDING SYSTEMS — Type SLT, SLT-H

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Type SLT

METAL-LITE INC — The System

QUAIL RUN BUILDING MATERIALS INC — Slotted Deflection Track

RAM SALES L L C — RAM Slotted Track

SCAFCO STEEL STUD MANUFACTURING CO

STEELER INC — Steeler Slotted Ceiling Runner

TELLING INDUSTRIES L L C — True-Action Deflection Track

THE STEEL NETWORK INC — VertiTrack VT, series,250VT, 362VT, 400VT, 600VT and 800VT

A2. **Light Gauge Framing* - Notched Ceiling Runner —** As an alternate to the ceiling runners in Items 2A through 2A2, notched ceiling runners to consist of C-shaped galv steel channel with notched return flanges sized to accommodate steel studs (Item 2B). Notched ceiling runner installed perpendicular to direction of fluted steel floor deck prior to the application of spray-applied fire resistive material and secured to valleys with steel masonry anchors spaced max 24 in. OC. When notched ceiling runner is used, deflection channel (Item 3A) shall not be used.

OLMAR SUPPLY INC — Type SCR

B. **Studs —** Steel studs to be min 3-1/2 in. (89 mm) wide. Studs cut 1/2 in. (13 mm) to 3/4 in. (19 mm) less in length than assembly height with bottom nesting in and secured to floor runner. When slotted ceiling runner (Item 2A1) is used, steel studs secured to slotted ceiling runner with No. 8 by 1/2 in. (13 mm) long wafer head steel screws at midheight of slot on each side of wall. When deflection channel (Item 3A) is used, steel studs attached to ceiling runner with sheet metal screws located 1/2 in. (13 mm) below the bottom of the deflection channel. When deflection channel is not used, studs to nest in ceiling runner without attachment. Stud spacing not to exceed 24 in. (610 mm) OC.

B1. **Light Gauge Framing* —Slotted Studs —** Slotted steel stud to be used in conjunction with **Light Gauge Framing* —Floor and Ceiling Runners** (Item 2A1). Slotted steel studs to be min 3-1/2 in. (89 mm) wide. Slotted steel studs cut 1/2 in. to 3/4 in. (13 to 19 mm) less in

length than assembly height with bottom nesting in and secured to both ceiling and floor runners. Ceiling runner secured to preformed slot within steel stud by means of No. 10 by 3/4 in. (19 mm) long low profile head steel screw. Floor runner attached to bottom of steel stud by means of No. 8 by 1/2 in. (13 mm) long pan head steel screw. Slotted steel stud spacing not to exceed 24 in. (610 mm) OC.

STEELER INC — Steeler Slotted Stud

C. **Gypsum Board* —** Gypsum board sheets installed to a min total 5/8 in. (16 mm) or 1-1/4 in. (32 mm) thickness on each side of wall for 1 and 2 hr fire rated assemblies, respectively. Wall to be constructed in the individual U400 Series Design in the UL Fire Resistance Directory, except that a max 1 in. (25 mm) gap shall be maintained between the top of the gypsum board and the bottom surface of the steel floor or roof deck. The screws attaching the gypsum board to the studs along the top of the wall shall be located 1 in. (25 mm) below the bottom of the ceiling runner. No gypsum board attachment screws shall be driven into the ceiling runner or into the optional deflection channel.

The hourly fire rating of the joint system is equal to the hourly fire rating of the wall.

3. **Joint System — Max separation between bottom of floor or roof deck and top of gypsum board (at time of installation of joint system) is 1 in. (25 mm). The joint system is designed to accommodate a max 18.75 percent compression or extension from its installed width.** The joint system shall consist of forming and fill materials, with or without a deflection channel (Item 2A), as follows:

A. **Deflection Channel —** (Optional, Not Shown) — Max 2 in. (51 mm) deep min 24 gauge galv steel channel sized to accommodate ceiling runner (Item 2A). Deflection channel installed perpendicular to direction of fluted steel deck prior to the application of spray-applied fire resistive material and secured to steel floor or roof deck valleys with steel masonry anchors fasteners or welds spaced max 24 in. (610 mm) OC. The ceiling runner is installed within the deflection channel to maintain a 1/2 in. (13 mm) to 3/4 in. (19 mm) gap between the top of the ceiling runner and the top of the deflection channel. The ceiling runner nests inside the deflection channel without attachment.

B. **Forming Material* —** Min 5-5/8 in. (143 mm) or 7 in. (178 mm) thickness of 4 pcf (64 kg/m^3) mineral wool batt insulation for 1 and 2 hr fire rated assemblies, respectively, cut to the shape of the fluted deck and installed into the flutes of the steel floor or roof deck between the top of the deflection channel and the steel floor or roof deck. The mineral wool batt insulation is to be compressed min 14.3 percent in thickness such that it is flush with the gypsum board surface on both sides of the wall. Additional sections of mineral wool batt insulation are compressed 50 percent in thickness and installed cut edge first to completely fill the gap above the top of the gypsum board. The forming material shall be installed flush with both surfaces of wall.

INDUSTRIAL INSULATION GROUP L L C — MinWool-1200 Safing

ROCK WOOL MANUFACTURING CO — Delta Board

ROCKWOOL MALAYSIA SDN BHD — SAFE

ROXUL INC — SAFE

THERMAFIBER INC — Type SAF

B1. **Forming Material* —** (Optional, Not Shown) - Preformed mineral wool plugs, formed to the shape of the fluted floor units, friction fit to completely fill the flutes above the ceiling channel. The plugs shall project beyond each side of the ceiling runner and shall be recessed from both wall surfaces to accommodate the required thickness of fill material (Item 3C). Additional forming material, described in Item 3B, to be used in conjunction with the plugs to fill the gap between the top of gypsum board and bottom of steel deck.

THERMAFIBER INC — TopStop mineral wool deck plugs Type SAF batts

C. **Fill, Void or Cavity Material*-Sealant —** Min 1/8 in. (3.2 mm) wet thickness or 1/16 in. (1.6 mm) dry thickness of fill material spray applied on each side of the wall in the flutes of the steel floor or roof deck and between the top of the wall and the bottom of the steel floor or roof deck and overlap a min 1/2 in. (13 mm) onto gypsum board and a min 2 in. (51 mm) onto the spray applied material on both sides of wall.

SPECIFIED TECHNOLOGIES INC — SpecSeal AS200 Elastomeric Spray

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2016-09-01

Questions? Print this page Terms of Use Page Top

UL DESIGN F-C-2008

THROUGH-PENETRATION FIRESTOP SYSTEM

Assembly Usage Disclaimer

XHEZ - Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems

System No. F-C-2008

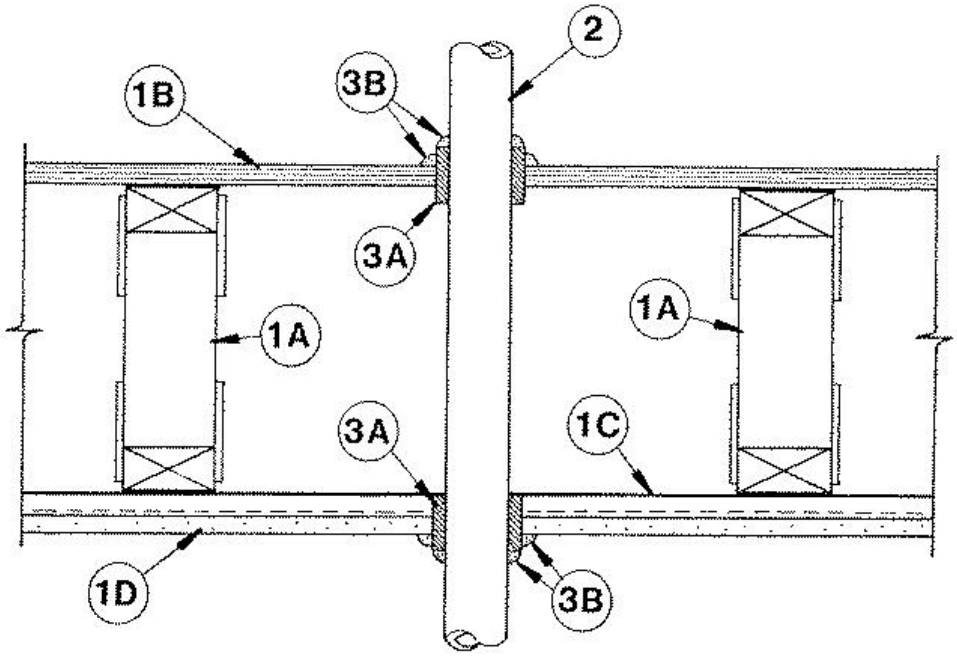
May 20, 2005

F Rating — 1 Hr

T Rating — 1 Hr

L Rating At Ambient — 7 CFM/sq ft (See Item 3B)

L Rating At 400 F — Less Than 1 CFM/sq ft (See Item 3B)



1. **Floor Assembly —** The fire rated wood truss or combination wood and steel truss Floor-Ceiling assembly shall be constructed of the materials and in the manner described in the individual L500 Series Design in the UL Fire Resistance Directory and shall include the following construction features:

A. **Trusses —** Min 12 in. (305 mm) deep parallel chord trusses fabricated from 2 by 4 in. (51 by 102 mm) lumber in conjunction with galv steel truss plates or **Structural Wood Members*** with bridging as required.

B. **Flooring —** Nom 3/4 in. (19 mm) thick plywood flooring with or without **Floor Topping Mixture*.** Diam of hole-sawed opening in flooring to be 1/2 to 3/4 in. (13 to 19 mm) larger than diam of pipe. Max diam of opening in flooring is 3 in. (76 mm).

C. **Furring Channels —** Rigid or resilient galv steel furring channels installed perpendicular to bottom chord of trusses.

D. **Gypsum Board* —** Nom 4 ft (1.22 m) wide by 5/8 in. (16 mm) thick, screw-attached to furring channels. Diam of hole-sawed opening in gypsum wallboard ceiling to be 1/2 to 3/4 in. (13 to 19 mm) larger than diam of pipe. Max diam of opening in ceiling is 3 in. (76 mm)

2. **Nonmetallic Pipe —** Nom 2 in. (51 mm) diam (or smaller) Schedule 40 polyvinyl chloride (PVC), SDR 13.5 chlorinated polyvinyl chloride (CPVC) or solid-core Schedule 40 acrylonitrile-butadiene-styrene (ABS) pipe for use in closed (process or supply) or vented (drain, waste or vent) piping systems. One pipe to be installed approx midway between trusses and centered in circular openings in flooring and in ceiling. A nom 1/4 in. to 3/8 in. (6 to 10 mm) annular space is required in the firestop system. Pipe to be rigidly supported on both sides of Floor-Ceiling assembly.

2A. **Electrical Nonmetallic Tubing+ —** Nom 1 in. (25 mm) diam (or smaller) corrugated wall ENT constructed of polyvinyl chloride. ENT to be installed as a complete system with all terminations in junction boxes, outlet boxes or other approved enclosures as specified in the National Electrical Code. Max one ENT per through opening. ENT to be centered in opening and rigidly supported on both sides of the Floor-Ceiling assembly.
See **Electrical Nonmetallic Tubing** (FKHU) category in Electrical Construction Materials Directory for names of manufacturers.

3. **Firestop System —** The details of the firestop system shall be as follows:

A. **Fill, Void or Cavity Materials* — Wrap Strip —** Nom 1/4 in. (6 mm) thick intumescent elastomeric material faced on one side with aluminum foil, supplied to 2 in. (51 mm) wide strips. Nom 2 in. (51 mm) wide strip tightly-wrapped around nonmetallic pipe (foil side exposed), secured with two steel tie wires and slid into hole-sawed opening in flooring (Item 1B) and in gypsum wallboard ceiling (Item 1D). Bottom edge of wrap strip to project 9/16 to 11/16 in. (14 to 17.5 mm) below bottom surface of flooring and below bottom (ceiling) surface of gypsum board.
3M COMPANY — Type FS-195+

B. **Fill, Void or Cavity Materials* — Caulk, Sealant or Putty —** Nom 1/4 in. (6 mm) thickness of caulk or putty to be applied to the exposed edge of the wrap strip layer (top of flooring and bottom of gypsum board ceiling). Generous application of caulk or putty to be applied to fill all gaps at the wrap strip/flooring and wrap strip/gypsum board ceiling interfaces.
3M COMPANY — CP 25WB+ Caulk, FB-3000 WT Sealant, MP+ Stix Putty (Note: L Ratings apply only when Type CP 25WB+ caulk or FB-3000 WT sealant is used. CP 25WB+ not suitable for use with CPVC pipes.)

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2005-05-20

Design/System/Construction/Assembly Usage Disclaimer

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- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

UL DESIGN F-C-2026

THROUGH-PENETRATION FIRESTOP SYSTEM

Assembly Usage Disclaimer

XHEZ - Through-penetration Firestop Systems

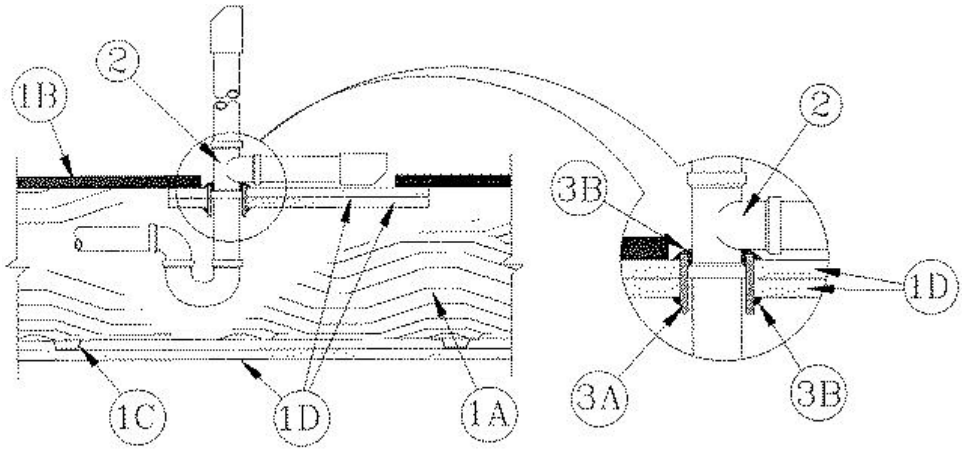
See General Information for Through-penetration Firestop Systems

System No. F-C-2026

May 18, 2005

F Rating — 1 Hr

T Rating — 1 Hr



1. **Floor-Ceiling Assembly —** The fire-rated solid or trussed lumber joist Floor-Ceiling assembly shall be constructed of the materials and in the manner specified in the individual L500 Series Floor-Ceiling Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Joists —** Nom 10 in. (254 mm) deep (or deeper) lumber, steel or combination lumber and steel joists, trusses or **Structural Wood Members*** with bridging as required and with ends firestopped.

B. **Flooring System —** Lumber or plywood subfloor with finish floor of lumber, plywood or **Floor Topping Mixture*** as specified in the individual Floor-Ceiling Design. Rectangular cutout in flooring to accommodate the bathtub drain piping (Item 2) to be max 8 by 12 in. (203 by 305 mm)

C. **Furring Channels —** Rigid or resilient galv steel furring channels installed perpendicular to joists.

D. **Gypsum Board* —** Nom 4 ft (122 cm) wide by 5/8 in. (16 mm) thick. Gypsum board screw-attached to furring channels as specified in the individual Floor-Ceiling Design. Two pieces of gypsum board, each min 4 in. (102 mm) longer and wider than the cutout in the flooring, screw-attached to bottom of flooring concentric with cutout. Diam of opening hole-sawed through both layers of the gypsum board patch to be 1/2 to 5/8 in. (13 to 16 mm) larger than outside diam of bathtub drain piping (Item 2).

2. **Drain Piping —** Nom 1-1/2 in. (38 mm) diam Schedule 40 PVC pipe and drain fittings cemented together and provided with PVC bathtub waste/overflow fitting.

3. **Firestop System —** The details of the firestop system shall be as follows:

A. **Fill, Void or Cavity Materials* — Wrap Strip —** Nom 1/4 in. (6 mm) thick intumescent elastomeric material faced on one side with aluminum foil, supplied in 2 in. (51 mm) wide strips. Nom 2 in. (51 mm) wide strip tightly-wrapped around PVC drain piping (foil side exposed), secured with two steel wire ties, and slid into hole-sawed opening in gypsum board patch (Item 1D). Bottom edge of wrap strip to project approx 1/2 in. (13 mm) below bottom surface of gypsum board patch.
3M COMPANY — FS-195+

B. **Fill, Void or Cavity Materials* — Caulk or Sealant —** Nom 1/4 in. (6 mm) diam bead of caulk to be applied to perimeter of wrap strip at its egress from the underside of the gypsum board patch. Nom 1/4 in. (16 mm) thickness of caulk to be applied to the exposed edge of the wrap strip layer and to fill all gaps between the wrap strip layer and the tee of the drain fitting on the top surface of the gypsum board patch.
3M COMPANY — CP 25WB+, IC 15WB+, FireDam 150+ caulk or FB-3000 WT sealant

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Last Updated on 2005-05-18

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- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
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UL DESIGN F-C-2030

THROUGH-PENETRATION FIRESTOP SYSTEM

Assembly Usage Disclaimer

XHEZ - Through-penetration Firestop Systems

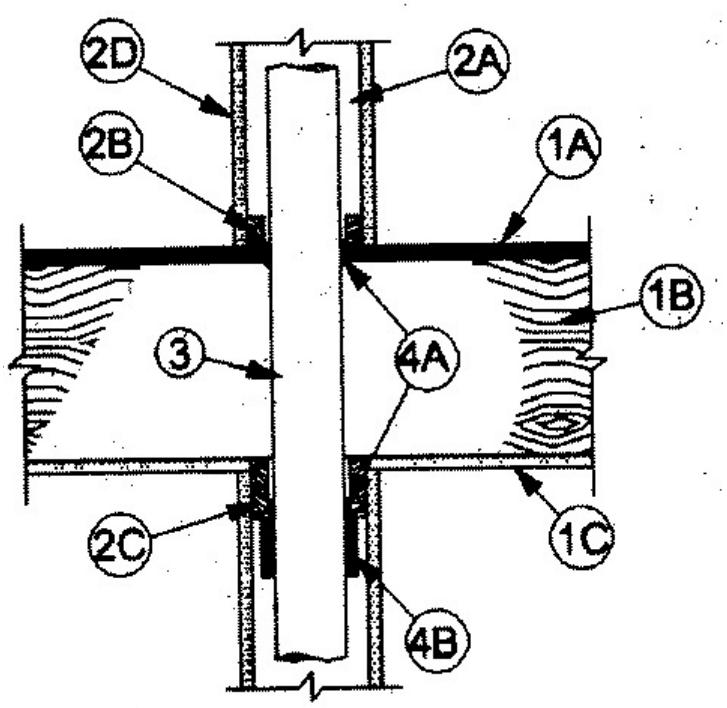
See General Information for Through-penetration Firestop Systems

System No. F-C-2030

April 06, 2018

F Ratings — 1 and 2 Hr (See tem 1)

T Ratings — 0, 3/4, 1, 1-1/2 and 2 Hr (See Item 3)



System tested with a pressure differential of 2.5 Pa between the exposed and the unexposed surfaces with the higher pressure on the exposed side.

1. **Floor-Ceiling Assembly —** The 1 or 2 hr fire-rated solid or trussed lumber joist floor-ceiling assembly shall be constructed of the materials and in the manner specified in the individual L500 Series Floor-Ceiling Designs in the UL Fire Resistance Directory. **The F Rating of the firestop system is equal to the rating of the floor-ceiling and wall assemblies.** The general construction features of the floor-ceiling assembly are summarized below:

A. **Flooring System —** Lumber or plywood subfloor with finish floor of lumber, plywood or **Floor Topping Mixture*** as specified in the individual Floor-Ceiling Design. Diam of opening shall be 1 in. (25 mm) larger than the nom diam of through-penetrant (Item 3).

B. **Joists —** Nom 10 in. (254 mm) deep (or deeper) lumber, steel or combination lumber and steel joists, trusses or **Structural Wood Members*** with bridging as required and with end firestopped.

C. **Gypsum Board* —** Thickness, type, number of layers and fasteners shall be as specified in the individual Floor-Ceiling Design. Diam of opening shall be 1 in. (25 mm) larger than the nom diam of through-penetrant (Item 3).

D. **Furring Channels —** (Not Shown) (As required) - Resilient galvanized steel furring installed in accordance with the manner specified in the individual L500 Series Designs in the Fire Resistance Directory.

2. **Chase Wall —** (Optional) - The through penetrant (Item 3) may be routed through a fire-rated or non-rated single, double or staggered wood stud/gypsum wallboard chase wall. The chase wall shall be constructed to include the following construction features:

A. **Studs —** Nom 2 by 6 in. (51 by 152 mm) or double nom 2 by 4 in. (51 by 102 mm) lumber studs.

B. **Sole Plate —** Nom 2 by 6 in. (51 by 152 mm) (or larger) or parallel 2 by 4 in. (51 by 102 mm) lumber plates, tightly butted. Diam of opening shall be 1 in. (25 mm) larger than the nom diam of through-penetrant (Item 3).

C. **Top Plate —** The double top plate shall consist of two nom 2 by 6 in. (51 by 152 mm) (or larger) or parallel 2 by 4 in. (51 by 102 mm) lumber plates, tightly butted. Diam of opening shall be 1 in. (25 mm) larger than the nom diam of through-penetrant (Item 3).

D. **Gypsum Board* —** One or two layers of min 1/2 in. (13 mm) gypsum board.

3. **Through-Penetrants —** One nom 1-1/2 in. (38 mm), 2 in. (51 mm), 3 in. (76 mm) or 4 in. (102 mm) diam nonmetallic pipe to be installed within the firestop system. Diam of opening through flooring system and through sole and top plates of chase wall to be max 2-1/8 in. (54 mm), 2-5/8 in. (67 mm), 4 in. (102 mm) or 5 in. (127 mm) for nom 1-1/2 in. (38 mm), 2 in. (51 mm), 3 in. (76 mm) or 4 in. (102 mm) diam nonmetallic pipe sizes, respectively. Pipe to be rigidly supported on both sides of the floor-ceiling assembly. The T Rating is dependent on the size of the through-penetrant. For 2 hr rated assemblies, the T Rating is 2 hr for 1-1/2 in. (38 mm) diam (and smaller) pipes and 1-1/2 hr for pipes greater than 1-1/2 in. (38 mm) diam. For 1 hr rated assemblies, the T rating is 1 hr for 1-1/2 in. (38 mm) diam (and smaller) pipes, 3/4 hr for 2 in. (51 mm) diam pipes and 0 hr for pipes greater than 2 in. (51 mm) diam. The following types of nonmetallic pipes may be used:

A. **Polyvinyl Chloride (PVC) Pipe —** Schedule 40 solid-core or cellular core PVC pipe for use in closed (process or supply) or vented (drain, waste or vent) piping system.

B. **Chlorinated Polyvinyl Chloride (CPVC) Pipe —** SDR17 CPVC pipe for use in closed (process or supply) or vented (drain, waste or vent) piping systems.

C. **Acrylonitrile Butadiene Styrene (ABS) pipe —** Schedule 40 solid-core or cellular core ABS pipe for use in closed (process or supply) or vented (drain, waste or vent) piping systems.

D. **Flame Retardant Polypropylene(FRPP) Pipe —** Schedule 40 FRPP pipe for use in closed (process or supply) or vented (drain, waste or vent) piping system.

4. **Firestop System —** The details of the firestop system shall be as follows:

A. **Fill, Void or Cavity Material* — Sealant —** Min 3/4 in. (19 mm) thickness of fill material to be installed within the annular space between the pipe and the flooring (Item 1A) or sole plate. Min 5/8 in. (16 mm) thickness applied within the annular space, flush with the bottom surface of ceiling or lower top plate.
HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealantor FS-ONE MAX Intumescent Sealant.

B. **Firestop Device* — Firestop Collar —** Firestop collar shall be installed in accordance with the accompanying installation instructions. Collar to be installed and latched around the pipe and secured to underside of ceiling or chase wall top plate (Item 2C) using the anchor hooks provided with the collar. (Minimum 2 anchor hooks for 1-1/2 (38 mm) and 2 in. (51 mm) diam pipes and 3 anchor hooks for 3 in. (76 mm) diam pipes). The anchor hooks are to be secured to the ceiling with min 3/16 in. (5 mm) diam steel toggler bolts or

to the chase wall top plate with min No. 12 by min 1 in. (25 mm) long steel wood screws in conjunction with steel washers.
HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP 643 50/1.5"N, CP643 63/2"N, CP 643 90/3"N or CP643 110/4"N Firestop Collar

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2018-04-06

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UL DESIGN F-C-3007

THROUGH-PENETRATION FIRESTOP SYSTEM

Assembly Usage Disclaimer

XHEZ - Through-penetration Firestop Systems

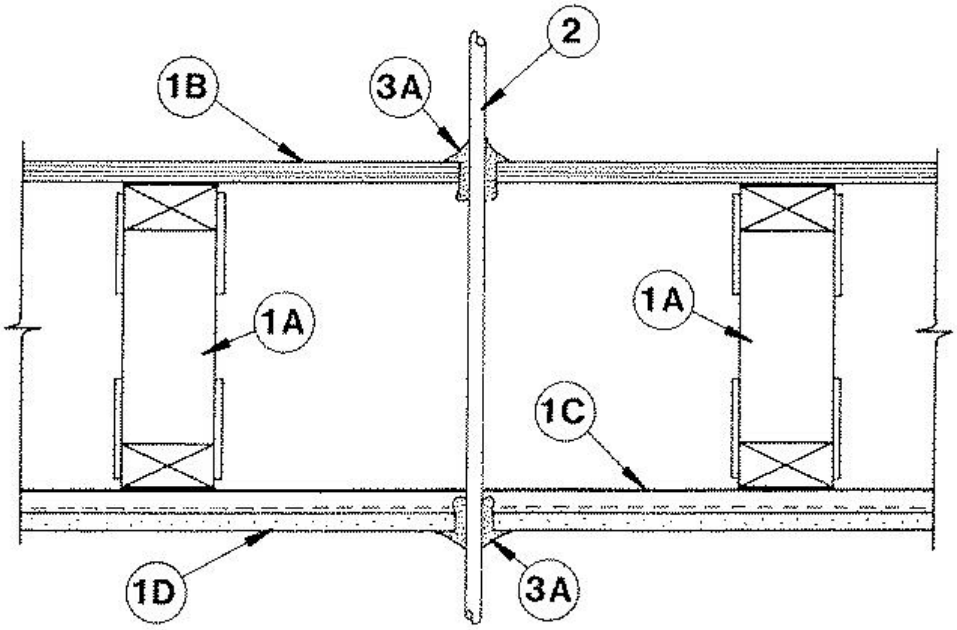
See General Information for Through-penetration Firestop Systems

System No. F-C-3007

August 18, 2011

F Rating — 1 Hr

T Rating — 1 Hr



1. **Floor Assembly —** The 1 hr fire rated wood truss or combination wood and steel truss Floor-Ceiling assembly shall be constructed of the materials and in the manner described in the individual L500 Series Design in the UL Fire Resistance Directory, as summarized below:

A. **Trusses —** Min 12 in. (305 mm) deep parallel chord trusses fabricated from nom 2 by 4 in. (51 by 102 mm) lumber in conjunction with galv steel truss plates or **Structural Wood Members*** with bridging as required.

B. **Flooring —** Nom 3/4 in. (19 mm) thick plywood flooring with or without **Floor Topping Mixture*** . Max diam of opening is 1-1/4 in. (32 mm).

C. **Furring Channels —** Rigid or resilient galv steel furring channels installed perpendicular to bottom chord of trusses.

D. **Gypsum Board* —** Nom 4 ft (1.22 m) wide by 5/8 in. (16 mm) thick, screw-attached to furring channels. Max diam of opening is 1-1/4 in. (32 mm).

1.1 **Chase Wall —** (Optional, Not Shown) — The through penetrants (Item No. 2) may be routed through a 1 hr fire-rated single, double or staggered wood stud/gypsum board chase wall constructed of the

materials and in the manner specified in the individual U300 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Nom 2 by 6 in. (51 by 152 mm) or double nom 2 by 4 in. (51 by 102 mm) lumber studs.

B. **Sole Plate —** Nom 2 by 6 in. (51 by 152 mm) or parallel 2 by 4 in. (51 by 102 mm) lumber plates, tightly butted.

C. **Top Plate —** The double top plate shall consist of two nom 2 by 6 in. (51 by 152 mm) or two sets of parallel 2 by 4 in. (51 by 102 mm) lumber plates, tightly butted. Max diam of opening is 1-1/2 in. (38 mm)

D. **Gypsum Board* —** Thickness, type, number of layers and fasteners shall be as specified in individual Wall and Partition Design.

2. **Cables —** One cable to be installed eccentrically or concentrically in opening with annular space between the cable and the periphery of the opening of min 0 in. (0 mm, point contact) to max 1-1/4 in. (32 mm). Cable to be rigidly supported on both sides of Floor-Ceiling assembly. The following types of cables may be used.

A. Max seven conductor No. 12 AWG (or smaller) power/control cables with polyvinyl chloride insulation and jacket materials.

B. Max 100 pair No. 22 AWG (or smaller) telecommunication cables with polyvinyl chloride insulation and jacket materials.

C. Max four conductor with ground No. 2/0 AWG (or smaller) aluminum SER cables with polyvinyl chloride insulation and jacket materials.

2A. **Through Penetrating Product* —** Max one through-penetrating product to be installed eccentrically or concentrically in opening with annular space between the through-penetrating product and the periphery of the opening of min 0 in. (0 mm, point contact) to max 1-1/4 in. (32 mm). Through-penetrating product to be rigidly supported on both sides of floor or wall assembly. The following types of through-penetrating products may be used:

A. Max four copper conductors No. 2/0 AWG (or smaller) aluminum or steel **Armored Cable#** or **Metal-Clad Cable+**.
AFC CABLE SYSTEMS INC

B. Two or more twisted copper conductor No. 6 AWG (or smaller) **Power Limited Circuit Cable+** with or without a jacket under a metal armor.
AFC CABLE SYSTEMS INC

C. Two or more twisted copper conductor No. 10 AWG (or smaller) **Power Limited Fire Alarm Cable+** with or without a jacket under a metal armor.
AFC CABLE SYSTEMS INC

D. Two or more twisted copper conductor No. 12 AWG (or smaller) **Non Power Limited Fire Alarm Cable+** with or without a jacket under a metal armor.
AFC CABLE SYSTEMS INC

3. **Fill, Void or Cavity Materials* — Caulk, Sealant or Putty —** Min 3/4 in. (19 mm) thickness of fill material applied within the annulus, flush with top surface of floor or sole plate. Min 5/8 in. (16 mm) thickness of fill material applied within the annulus, flush with bottom surface of ceiling or top plate. An additional min 1/4 in. (6 mm) crown of fill material applied to perimeter of penetrant at its egress from the top of flooring and underside of ceiling or from top of sole plate and underside of top plate.
3M COMPANY — CP 25WB+ caulk, MP+ Stix putty or FB-3000 WT sealant

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

+Bearing the UL Listing Mark

Last Updated on 2011-08-18

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The appearance of a company's name or product in this database does not in itself assure that products so identified have been manufactured under UL's Follow-Up Service. Only those products bearing the UL Mark should be considered to be Certified and covered under UL's Follow-Up Service. Always look for the Mark on the product.

UL DESIGN F-C-5002

THROUGH-PENETRATION FIRESTOP SYSTEM

Assembly Usage Disclaimer

XHEZ - Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems

System No. F-C-5002

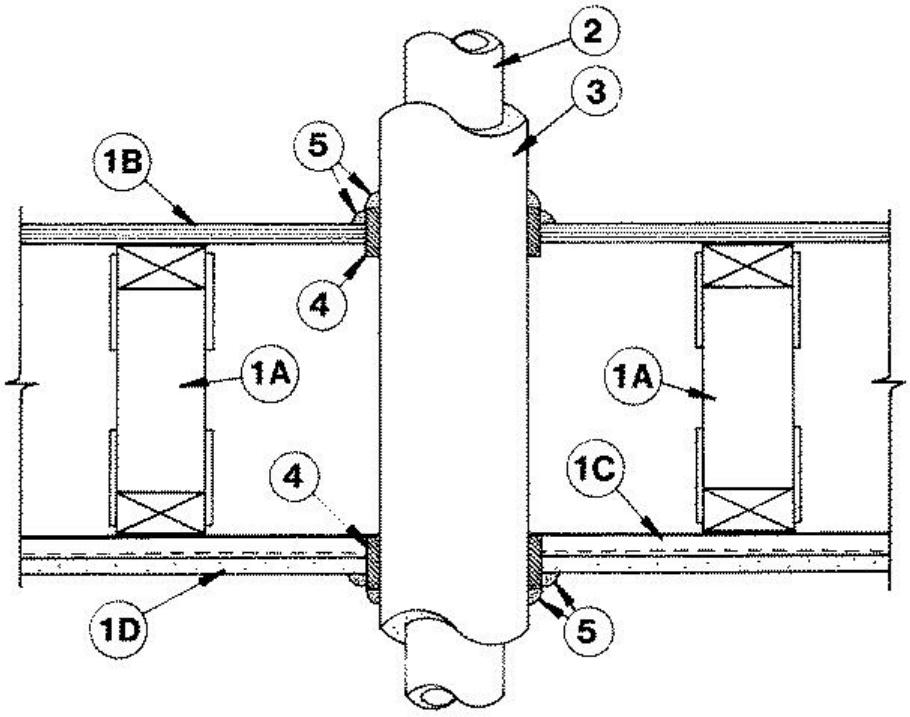
May 19, 2005

F Rating — 1 Hr

T Rating — 1 Hr

L Rating At Ambient — 7 CFM/sq ft

L Rating At 400 F — Less Than 1 CFM/sq ft



1. **Floor Assembly —** The fire rated wood truss or combination wood and steel truss Floor-Ceiling assembly shall be constructed of the materials and in the manner described in the individual L500-Series Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Trusses —** Min 12 in. (305 mm) deep parallel chord trusses fabricated from nom 2 by 4 in. (51 by 102 mm) lumber in conjunction with galv steel truss plates or **Structural Wood Members*** with bridging as required.

B. **Flooring —** Nom 3/4 in. (19 mm) thick plywood flooring with or without **Floor Topping Mixture***. Max diam of hole-sawed opening in flooring is 7 in. (178 mm).

C. **Furring Channels —** Rigid or resilient galv steel furring channels installed perpendicular to bottom chord of trusses.

D. **Gypsum Board* —** Nom 4 ft (122 cm) wide by 5/8 in. (16 mm) thick, screw-attached to furring channels. Max diam of hole-sawed opening in gypsum board ceiling is 7 in. (178 mm).

2. **Pipe —** Nom 4 in. (102 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe or nom 3 in. (76 mm) diam (or smaller) Type L (or heavier) copper pipe. Pipe to be installed approximately midway between trusses and centered in circular cutouts in flooring (Item 1B) and gypsum board ceiling (Item 1D). Diam of circular cutouts in flooring and gypsum wallboard ceiling to be 1/2 to 3/4 in. (13 to 19 mm) larger than outside diam of pipe covering (Item 3) or tube insulation (Item 3A) on pipe. Pipe to be rigidly supported on both sides of Floor-Ceiling assembly.

3. **Pipe Covering* —** Nom 1 in. (25 mm) thick hollow cylindrical heavy density (min 3.5 pcf or 56 kg/m^3) glass fiber units jacketed on the outside with an all service jacket. Longitudinal joints sealed with metal fasteners or factory-applied self-sealing lap tape. Transverse joints secured with metal fasteners or with butt strip tape supplied with the product.
See **Pipe and Equipment Covering — Materials*** (BRGU) category in Building Materials Directory for names of manufacturers. Any pipe covering material meeting the above specifications and bearing the UL Classification Marking with a Flame Spread Index of 25 or less and a Smoke Developed Index of 50 or less may be used.

3A. **Tube Insulation — Plastics+ —** As an alternate to the glass fiber pipe covering (Item 3), nom 1/2 or 5/8 in. (13 or 16 mm) thick acrylonitrile butadiene/polyvinyl chloride (AB/PVC) flexible foam furnished in the form of tubing with skin may be used.
See **Plastics (QMFZ2)** category in the Recognized Component Directory for names of manufacturers. Any Recognized Component tube insulation material meeting the above specifications and having a UL 94 Flammability Classification of 94-5VA may be used.

4. **Fill, Void or Cavity Materials* — Wrap Strip —** Nom 1/4 in. (6 mm) thick intumescent elastomeric material faced on one side with aluminum foil, supplied in 2 in. (51 mm) wide strips. Nom 2 in. (51 mm) wide strip tightly wrapped around pipe covering or tube insulation (foil side exposed), secured with two steel tie wires and slid into hole-sawed opening in flooring (Item 1B) and in gypsum wallboard ceiling (Item 1D). Bottom edge of wrap strip to project 9/16 to 11/16 in. (14 to 18 mm) below bottom surface of flooring and below bottom (ceiling) surface of gypsum wallboard.
3M COMPANY — Types FS-195, FS-195+

5. **Fill, Void or Cavity Materials* — Caulk or Sealant —** Nom 1/4 in. (6 mm) thickness of caulk to be applied to the exposed edge of the wrap strip layer (top of flooring and bottom of gypsum board ceiling). Generous application of caulk to be applied to fill all gaps at the wrap strip/flooring and wrap strip/gypsum board ceiling interfaces.
3M COMPANY — CP 25WB+, IC 15WB+, FireDam 150+ caulk or FB-3000 WT sealant

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2005-05-19

Design/System/Construction/Assembly Usage Disclaimer

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UL DESIGN W-L-2093

THROUGH-PENETRATION FIRESTOP SYSTEM

Assembly Usage Disclaimer

XHEZ - Through-penetration Firestop Systems

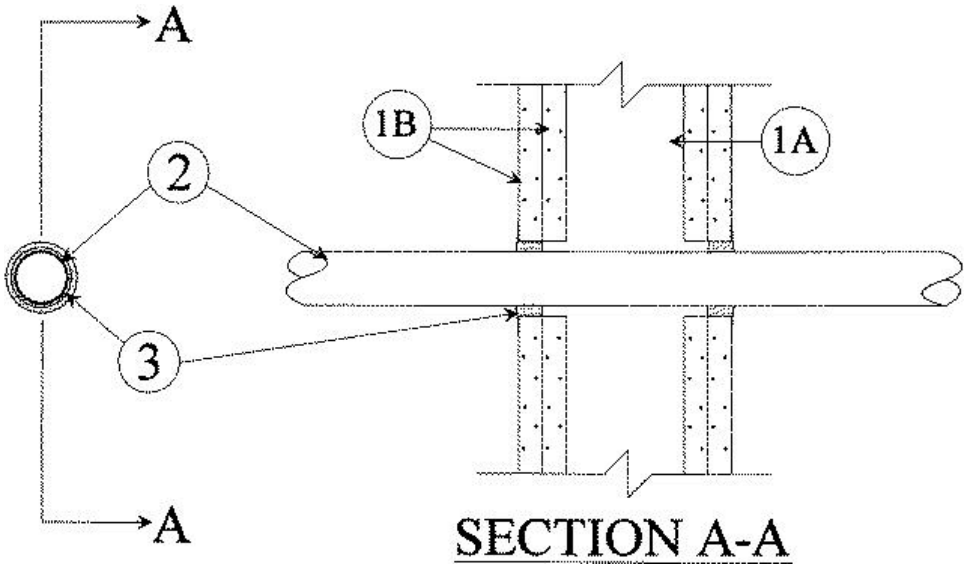
See General Information for Through-penetration Firestop Systems

System No. W-L-2093

December 09, 2008

F Ratings — 1 & 2 Hr. (See Item 1)

T Ratings — 1 and 1-1/2 Hr.(See Item 2)



1. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner described in the individual U300 or U400 Series Wall or Partition Design in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. lumber spaced 16 in. O.C. with nom 2 by 4 in. lumber end plates and cross braces. Steel studs to be min 3-5/8 in. wide and spaced max 24 in. O.C.

B. **Gypsum Board* —** 5/8 in. thick, 4 ft wide with square or tapered edges. The gypsum wallboard type, thickness, number of layers, fastener type and sheet orientation shall be as specified in the individual U300 or U400 Series Design in the UL Fire Resistance Directory. Max diam of opening is 3 in.
The hourly F Rating of the firestop system is equal to the hourly fire rating of the wall assembly in which it is installed.

2. **Through Penetrants —** One nonmetallic pipe, conduit or raceway to be centered within the firestop system. A nom annular space of 5/16 in. is required within the firestop system. Pipe, conduit or raceway to be rigidly supported on both sides of the floor or wall assembly. The following types and sizes of nonmetallic pipes, conduits or raceway may be used:

A. **Polyvinyl Chloride (PVC) Pipe —** Nom 2 in. diam (or smaller) Schedule 40 cellular or solid core PVC pipe for use in closed (process or supply) piping systems.

B. **Rigid Nonmetallic Conduit+ —** Nom 2 in. diam (or smaller) Schedule 40 PVC conduit installed in accordance with Article 347 of the National Electrical Code (NFPA No. 70).

C. **Chlorinated Polyvinyl Chloride (CPVC) Pipe —** Nom 2 in. diam (or smaller) SDR17 CPVC pipe for use in closed (process or supply) piping systems.

D. **Optical Fiber Raceway+ —** Nom 2 in. diam (or smaller) optical fiber raceway formed from polyvinyl chloride (PVC) or nom 1-1/4 in. diam (or smaller) optical fiber raceway formed from polyvinylidene fluoride (PVDF). Raceway to be installed in accordance with Article No. 770 of the National Electrical Code. Raceway to be rigidly supported on both sides of wall assembly.
See Optical Fiber Raceway (QAZM) category in the Electrical Construction Materials Directory for names of manufacturers.

E. **Electrical Nonmetallic Tubing+ —** Nom 2 in. diam (or smaller) PVC tubing installed in accordance with Article 331 of the National Electrical Code (NFPA No. 70). See **Electrical Nonmetallic Tubing** (FKHU) category in the Electrical Construction Materials Directory for names of manufacturers.
The hourly T Rating of the firestop system is dependent upon the hourly fire rating of the wall and the diam of the through-penetrant as shown below:

Wall Hr	Max Diam of Through Penetrant In.	T Rating Hr
1	2	1
1	1-1/4	1
2	2	1
2	1-1/4	1-1/2

3. **Fill, Void or Cavity Material* — Sealant —** Min 5/8 in. thickness of fill material applied within annulus, flush with both surfaces of wall. Additional fill material to be installed such that a min 1/4 in. thick crown is formed around the penetrating item and lapping 1 in. beyond the periphery of the opening.
SPECIFIED TECHNOLOGIES INC — SpecSeal Series SSS Sealant or SpecSeal LCI Sealant

+Bearing the UL Listing Mark

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Last Updated on 2008-12-09

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UL DESIGN W-L-2101

THROUGH-PENETRATION FIRESTOP SYSTEM

Assembly Usage Disclaimer

XHEZ - Through-penetration Firestop Systems

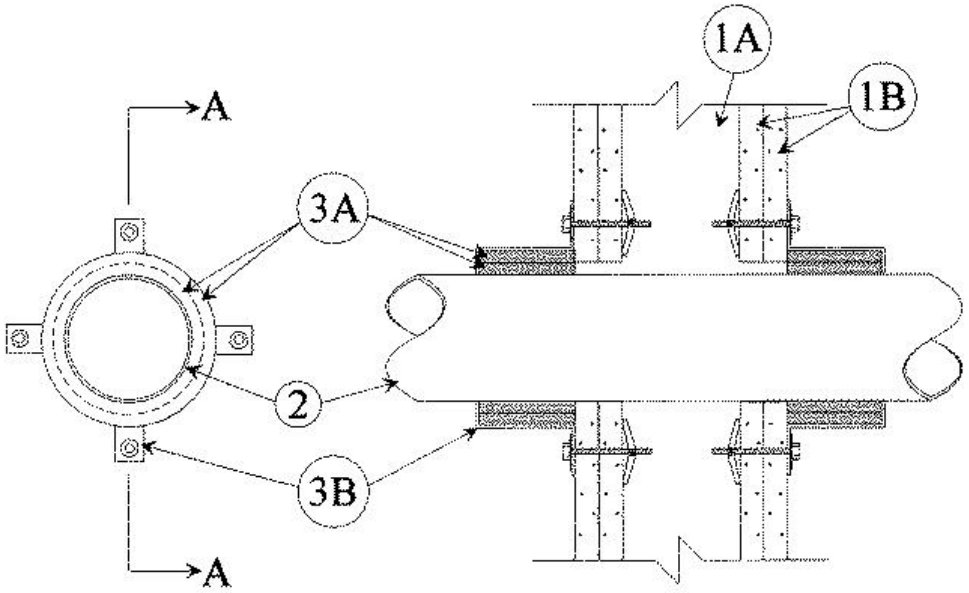
See General Information for Through-penetration Firestop Systems

System No. W-L-2101

December 10, 2008

F Ratings — 1 and 2 Hr (See Item 1)

T Ratings — 1 and 1-1/2 Hr (See Item 1)



SECTION A-A

1. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner specified in the individual U300 or U400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. lumber spaced 16 in. OC. Steel studs to be min 3-5/8 in. wide and spaced max 24 in. OC.

B. **Gypsum Board* —** 5/8 in. thick, 4 ft wide with square or tapered edges. The gypsum wallboard type, thickness, number of layers, fastener type and sheet orientation shall be as specified in the individual U300 or U400 Series Design in the UL Fire Resistance Directory. Max diam of opening is 5 in.
The hourly F and T Ratings of the firestop system are dependent on the hourly fire rating of the wall assembly in which it is installed as shown in the table below:

Rating of Wall Hr	F Rating Hr	T Rating Hr
2	2	1-1/2

1	1	1

2. **Through Penetrants —** One nonmetallic pipe or conduit to be either concentrically or eccentrically within the firestop system. The annular space between pipe or conduit and periphery of opening shall be min 0 in. (point contact) to max 1/2 in. Pipe or conduit to be rigidly supported on both sides of the wall assembly. The following types and sizes of nonmetallic pipes or conduit may be used:

A. **Polyvinyl Chloride (PVC) Pipe —** Nom 4 in. diam (or smaller) Schedule 40 cellular or solid core PVC pipe for use in closed (process or supply) or vented (drain, waste, or vent) piping systems.

B. **Chlorinated Polyvinyl Chloride (CPVC) Pipe —** Nom 4 in. diam (or smaller) SDR 17 CPVC pipe for use in closed (process or supply) or vented (drain, waste, or vent) piping systems.

C. **Rigid Nonmetallic Conduit+ —** Nom 4 in. diam (or smaller) Schedule 40 PVC conduit installed in accordance with Article 347 of the National Electrical Code (NFPA 70).

3. **Firestop System —** The firestop system shall consist of the following:

A. **Fill, Void or Cavity Material* — Wrap Strip —** Nom 1/4 in. thick intumescent material faced on both sides with a plastic film, supplied in 1-1/2 in. wide strips. The layers of wrap strips are individually wrapped around the through penetrant with ends butted and held in place with masking tape. Butted ends in successive layers may be aligned or offset. The edge of the wrap strips shall abut each surface of the wall. The layers of wrap strips are installed on each side of the wall. The number of layers of wrap strip are dependent on the diam of the pipe or conduit as tabulated below:

Diam Of Through Penetrant, In.	Layers Of Wrap Strip
4	2
3	2
2	1

SPECIFIED TECHNOLOGIES INC — SpecSeal RED Wrap Strip, SpecSeal Series SSS Sealant or SpecSeal LCI Sealant

C. **Steel Collar —** Collar fabricated from coils of precut 0.016 in. thick (No. 30 MSG) galv sheet steel available from wrap strip manufacturer. Collar shall be nom 1-1/2 in. deep with min four 1 in. wide by 2 in. long anchor tabs for securement to the wall. Retainer tabs, 3/4 in. wide tapering down to 1/4 in. wide and located opposite the anchor tabs, are folded 90 degree toward through penetrant surface to maintain the annular space around the through penetrant and to retain the wrap strips. Steel collar wrapped around wrap strips and through penetrant with a 1 in. wide overlap along its perimeter joint. Steel collar tightened around wrap strips and through penetrant using min 1/2 in. wide by 0.028 in. thick stainless steel hose clamp at midheight of steel collar. Collar secured to wall with 1/8 in. diam by min 2-3/4 in. long steel molly bolts in conjunction with min 1/4 in. by 1-1/4 in. diam steel fender washers. Steel collars are installed on each side of wall.

+Bearing the UL Listing Mark

*Bearing the UL Classification Marking

Last Updated on 2008-12-10

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UL DESIGN W-L-3001

THROUGH-PENETRATION FIRESTOP SYSTEM

Assembly Usage Disclaimer

XHEZ - Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems

System No. W-L-3001

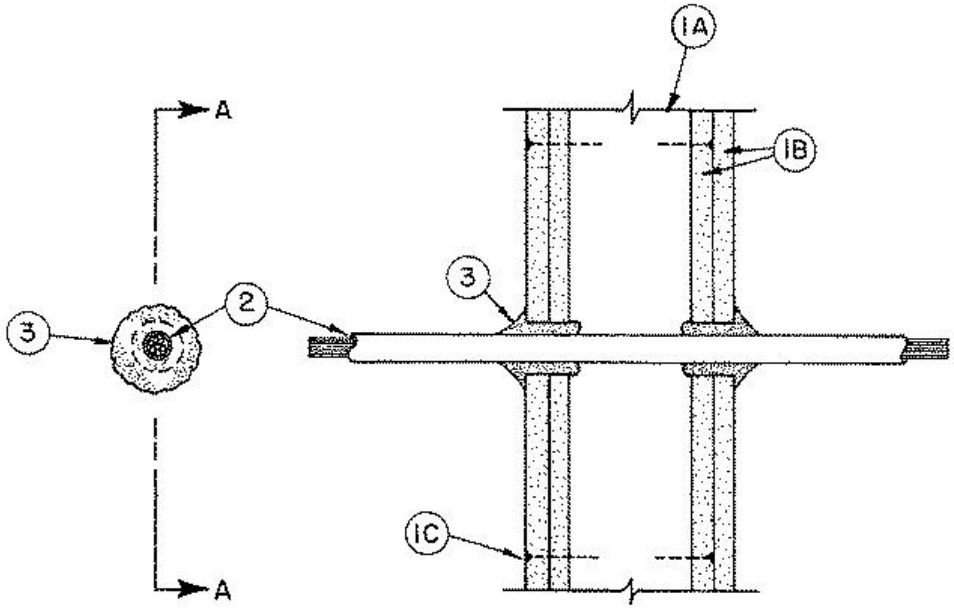
September 07, 2004

F Ratings — 1 and 2 Hr (See Item 1)

T Ratings — 3/4, 1, 1-1/2 and 2 Hr (See Item 2)

L Rating At Ambient — 15 CFM/sq ft (See Item 3)

L Rating At 400 F — less than 1 CFM/sq ft (See Item 3)



SECTION A-A

1. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner described in the individual U300 or U400 Series Wall or Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. lumber spaced 16 in. OC with nom 2 by 4 in. lumber end plates and cross braces. Steel studs to be min 3-5/8 in. wide by 1-3/8 in. deep channels spaced max 24 in OC.

B. **Gypsum Board* —** Nom 1/2 or 5/8 in. thick, 4 ft wide with square or tapered edges. The gypsum wallboard type, thickness, number of layers and sheet orientation shall be as specified in the individual Wall or Partition Design. Diam of circular through opening to be 3/8 in. to 5/8 in. larger than outside diam of cable or cable bundle.

C. **Fasteners —** When wood stud framing is employed gypsum wallboard layers attached to studs with cement coated nails as specified in the individual Wall or Partition Design. When steel channel stud framing is employed, gypsum wallboard attached to studs with Type S self-drilling, self-tapping bugle-head steel screws as specified in the individual Wall or Partition Design.
The hourly F Rating of the firestop system is equal to the hourly fire rating of the wall assembly in which it is installed.

2. **Cables —** Individual cable or max 1 in. diam cable bundle installed in through opening with an annular space of min 0 in. (point contact) to max 3/4 in. Cable to be rigidly supported on both sides of wall assembly. The following types and sizes of cables may be used:

A. Max 150 pair No. 24 AWG copper conductor telephone cable with polyvinyl chloride (PVC) insulation and jacket materials. **When max 25 pair telephone cable is used, T Rating is 2 hr. When 50 to 150 pair telephone cable is used in 1 hr fire rated wall, T Rating is 3/4 hr. When 50 to 150 pair telephone cable is used in 2 hr fire rated wall, T Rating is 1 hr.**

B. Max No. 10 AWG multiple copper conductor Type NM ("Romex") nonmetallic sheathed cable with PVC insulation and jacket materials. **When Type NM cable is used, max T Rating is 1-1/2 hr.**

C. Multiple fiber optical communication cable jacketed with PVC and having a max outside diam of 5/8 in. **When fiber optic cable is used, max T Rating is 2 hr.**

D. Max 12 AWG multiconductor (max seven conductors) power/control cable with cross-linked polyethylene (XLPE) insulation and XLPE or PVC jacket materials. **When multiconductor power/control cable is used, max T Rating is 2 hr.**

E. Max four conductor with ground No. 2 AWG (or smaller) aluminum SER cables with polyvinyl chloride insulation amd jacket materials.

3. **Fill, Void or Cavity Materials* — Caulk, Sealant or Putty —** Caulk or putty fill material installed to completely fill annular space between cable and gypsum wallboard on both sides of wall and with a min 1/4 in. diam bead of caulk or putty applied to perimeter of cable(s) at its egress from each side of the wall. **3M COMPANY** — MP+ putty, CP 25WB+ caulk or FB-3000 WT sealant. (Note: L Ratings apply only when Type CP 25WB+ caulk or FB-3000 WT sealant is used.)

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Last Updated on 2004-09-07

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UL DESIGN W-L-3076

THROUGH-PENETRATION FIRESTOP SYSTEM

Assembly Usage Disclaimer

XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

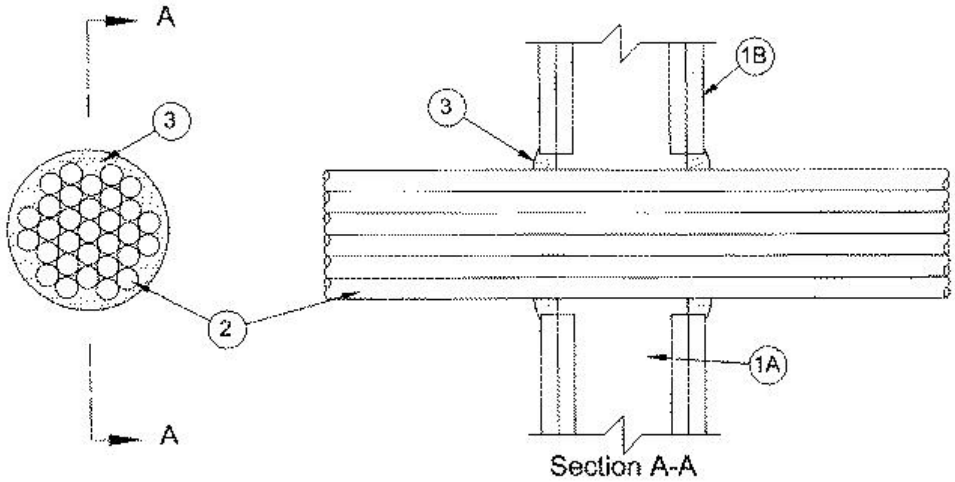
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. W-L-3076

August 23, 2011

ANSI/UL1479 (ASTM E814)	CAN/ULC S115	
F Ratings — 1 and 2 Hr (See Item 1)	F Ratings —1 and 2 Hr (See Item 1)	
T Rating — 0 Hr	FT Rating — 0 Hr	
	FH Ratings — 1 and 2 Hr (See Item 1)	
	FTH Rating — 0 Hr	



1. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner described in the individual U300, U400 or V400 Series Wall and Partition Design in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. (51 by 102 mm) lumber spaced 16 in. (406 mm) OC. Steel studs to be min 3-1/2 in. (89 mm) wide and spaced max 24 in. (610 mm) OC.

B. **Gypsum Board * —** The gypsum board type, thickness, number of layers, fastener type and sheet orientation shall be as specified in the individual U300, U400 or V400 Series Design in the UL Fire Resistance Directory. Diam of circular cutout in gypsum board layers in each side of wall to be 1/2 in. (13 mm) larger than diam of tight cable bundle (Item 2 or 2A). Max diam of opening is 4-1/2 in. (114 mm).
The hourly F Rating of the firestop system is equal to the hourly fire rating of the wall assembly in which it is installed.

2. **Cables —** Max 4 in. (102 mm) diam tight bundle of cables to be installed either concentrically or eccentricity in circular cutouts in gypsum board opening. Cables to be rigidly supported on both sides of wall assembly. The annular space within the firestop system shall be a min 0 in. (point contact) to a max 1/2 in. (13 mm). Any combination of the following types and sizes of cables may be used.

A. Max 150 pair No. 24 AWG (or smaller) copper conductor cable with polyvinyl chloride (PVC) insulation and jacket.

B. Max 1/C - 350 kcmil (or smaller) copper conductor cable with cross-linked polyethylene (XLPE) jacket.

C. Max 2/0 AWG (or smaller) copper conductor cable with a XLPE insulation and PVC jacket.

D. Max 3/C (with ground) No. 8 AWG nonmetallic sheathed (Romex) cable (or smaller) with copper conductor, polyvinyl chloride (PVC) insulation and jacket materials.

E. Max 3/C (with ground) No. 2/0 AWG (or smaller) aluminum or copper conductor service entrance cable with PVC insulation and jacket materials.

F. Max 4 pair No. 18 AWG (or smaller) copper conductor thermostat cable with PVC insulation and jacket materials.

G. Max RG/U Type 11 (or smaller) coaxial cable with fluorinated ethylene insulation and jacket materials.

H. Max 62.5/125 micron fiber optic cable with PVC insulation and jacket materials.

2A. **Through penetrating Product* —** As an alternate to the Item 2, a max 4 in. (102 mm) diam tight bundle of max 4 /C (with ground) - No. 2/0 AWG (or smaller) aluminum or steel jacketed **Armored Cable+** or **Metal-Clad Cable+** with aluminum or copper conductors may be used. The annular space between the cable bundle and the periphery of the opening shall be a min of 0 in. (point contact) to a max of 1 in. (25 mm). Through penetrating products may also be used in conjunction with the cables specified in Item 2. The through penetrating products are to be spaced min 1/2 in. (13 mm) from the cable bundle in Item 2. Cables to be rigidly supported on both sides of wall assembly.
AFC CABLE SYSTEMS INC

ENCORE WIRE CORP

3. **Fill, Void or Cavity Material* — Sealant —** Min 5/8 in. (16 mm) thickness of fill material applied within annulus, flush with both surfaces of wall. Fill material to be forced into interstices of cable group to max extent possible. At point contact location, apply min 1/4 in. (6 mm) diam bead of fill material at cable/gypsum board interface on both sides of wall.
SPECIFIED TECHNOLOGIES INC — SpecSeal Series SSS Sealant or SpecSeal LCI Sealant

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

\+ Bearing the UL Listing Mark

Last Updated on 2011-08-23

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UL DESIGN W-L-5040

THROUGH-PENETRATION FIRESTOP SYSTEM

Assembly Usage Disclaimer

XHEZ - Through-penetration Firestop Systems

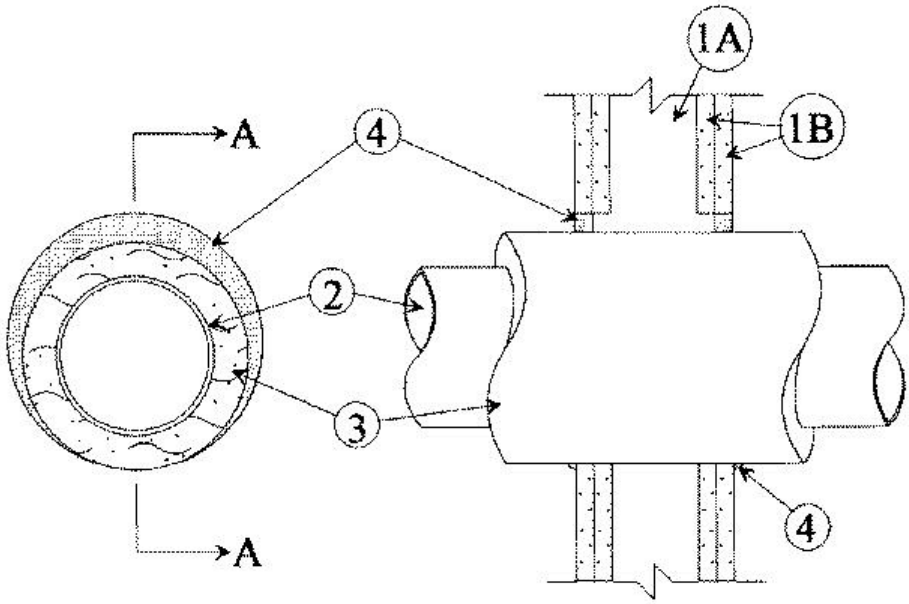
See General Information for Through-penetration Firestop Systems

System No. W-L-5040

September 07, 2004

F Ratings — 1 and 2 Hr (See Item 1)

T Ratings — 1/4, 1/2 and 3/4 Hr (See Item 2)



SECTION A-A

1. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner specified in the individual U300 or U400 Series Wall or Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. lumber spaced 16 in. OC. Steel studs to be min 3-5/8 in. wide and spaced max 24 in. OC.

B. **Gypsum Board* —** Nom 5/8 in. thick, 4 ft wide with square or tapered edges. The gypsum wallboard type, number of layers, fastener type and sheet orientation shall be as specified in the individual Wall and Partition Design. Max diam of opening in wallboard layers is 7 in.
The hourly F Rating of the firestop system is 1 hr when installed in a 1 hr fire rated wall and 2 hr when installed in a 2 hr fire rated wall.

2. **Through Penetrants —** One metallic pipe or tubing to be installed either concentrically or eccentrically within the firestop system. Pipe or tubing to be rigidly supported on both sides of wall assembly. The following types and sizes of metallic pipes or tubing may be used:

A. **Steel Pipe —** Nom 4 in. diam (or smaller) Schedule 10 (or heavier) steel pipe. **When steel pipe is used, T Rating is 3/4 hr.**

B. **Copper Tubing —** Nom 4 in. diam (or smaller) Type L (or heavier) copper tubing. **T Rating is 3/4 hr for copper tubing of nom 2 in. diam and smaller. For copper tubing greater than nom 2 in. diam, T Rating is 1/4 and 1/2 hr when installed in 1 and 2 hr rated walls, respectively.**

C. **Copper Pipe —** Nom 4 in. diam (or smaller) Regular (or heavier) copper pipe. **T Rating is 3/4 hr for copper pipe of nom 2 in. diam and smaller. For copper pipe greater than nom 2 in. diam, T Rating is 1/4 and 1/2 hr when installed in 1 and 2 hr rated wall respectively.**

3. **Pipe Insulation — Plastics# —** Nom 3/4 in. thick acrylonitrile butadiene/polyvinyl chloride (AB/PVC) flexible foam furnished in the form of tubing. The annular space between the insulated pipe and the edge of the through opening shall be min zero in. (point contact) to max 1-1/4 in.
See **Plastics#** (QMFZ2) category in the Recognized Component Directory for names of manufacturers. Any Recognized Component tube insulation material meeting the above specifications and having a UL94 Flammability Classification of 94-5VA may be used.

4. **Fill, Void or Cavity Materials* — Caulk or Sealant —** Min 5/8 in. thickness of caulk applied within the annular space, flush with each surface of wall. A min 1/2 in. diam bead of caulk shall be applied to the pipe insulation/ wallboard interface at the point contact location on both sides of wall.
3M COMPANY — CP 25WB+ or FB-3000 WT

*Bearing the UL Classification Marking

#Bearing the UL Recognized Component Marking

Last Updated on 2004-09-07

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UL DESIGN W-L-7019

THROUGH-PENETRATION FIRESTOP SYSTEM

Assembly Usage Disclaimer

XHEZ - Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems

System No. W-L-7019

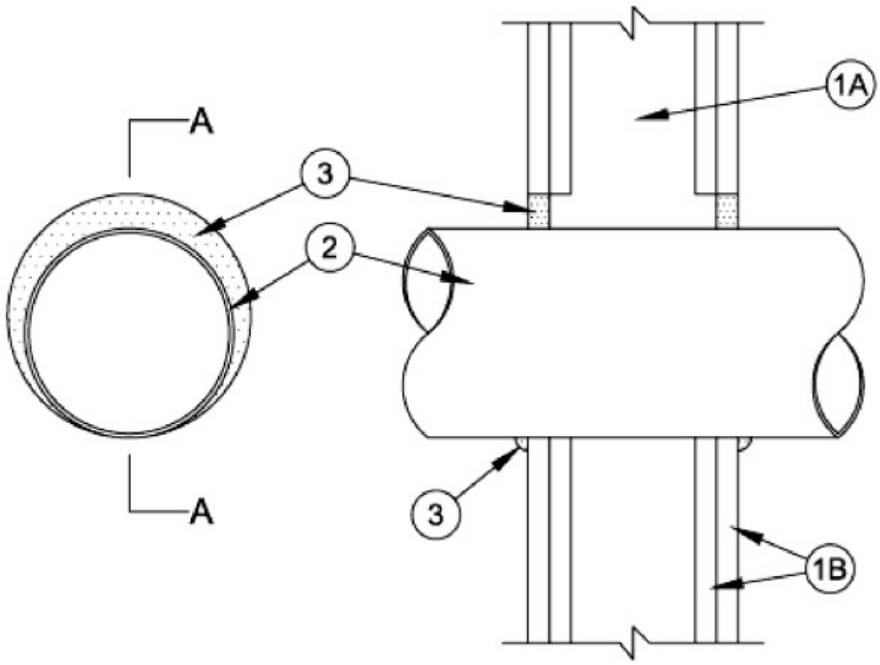
October 28, 2009

F Ratings — 1 & 2 Hr (See Item 1)

T Rating — 0 Hr

L Rating At Ambient - Less Than 1 CFM/sq ft

L Rating At 400 F - Less Than 1 CFM/sq ft



SECTION A-A

1. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner described in the individual U300, U400 or V400 Series Wall and Partition Design in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. (51 by 102 mm) lumber spaced 16 in. (406 mm) OC with nom 2 by 4 in. (51 by 102 mm) lumber end plates and cross braces. Steel studs to be min 3-1/2 in. (89 mm) wide and spaced max 24 in. (610 mm) OC.

B. **Gypsum Board* —** The gypsum board type, thickness, number of layers, fastener type and sheet orientation shall be as specified in the individual U300, U400 or V400

Series Design in the UL Fire Resistance Directory. Max diam of opening is 11 in.(279 mm).
The hourly F Rating of the firestop system is equal to the hourly fire rating of the wall assembly in which it is installed.

2. **Through Penetrant —** One nom 10 in. (254 mm) diam (or smaller) No. 28 MSG (or heavier) steel vent pipe to be installed either concentrically or eccentrically within the firestop system. The annular space between pipe and periphery of opening shall be min 0 in. (point contact) to max 1 in. (25 mm). Pipe to be rigidly supported on both sides of wall assembly.

3. **Fill, Void or Cavity Material* — Sealant —** Min 5/8 in. (16 mm) thickness of fill material applied within annulus, flush with both surfaces of wall. At the point contact location between through penetrant and gypsum board, a min 3/8 in. (10 mm) diam bead of fill material shall be applied at the gypsum board/through penetrant interface on both surfaces of wall.
SPECIFIED TECHNOLOGIES INC — SpecSeal Series SSS Sealant, SpecSeal LCI Sealant or Type WF300 Firestop Caulk (wood stud walls only).

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2009-10-28

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.
