SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes selective demolition, alteration and remodeling work indicated or required to produce finished results shown and includes the following:
   1. Demolition and removal of selected portions of a building.
   2. Demolition and removal of selected site elements.
   3. Patching and repairs.

1.02 RELATED SECTIONS

A. Section 01 11 00: Summary of Work for phasing requirements.
B. Divisions 22 and 23: sections for cutting, patching, or relocating Mechanical and Plumbing items.
C. Divisions 26, 27 and 28: sections for cutting, patching, or relocating Electrical, Telecom, Security, and Fire Alarm items.

1.03 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner’s property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner’s designated storage area.
C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.
D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.04 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner’s property, demolished materials shall become the Contractor’s property and shall be removed from the site with further disposition at the Contractor’s option.

1.05 SUBMITTALS

A. Comply with pertinent portions of Section 01 33 00.
B. Prior to cutting which affects structural safety, submit written request to the Architect for permission to proceed with cutting.
C. Record Drawings: Submit at project closeout according to Section 01 78 00.
   1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

1.06 QUALITY ASSURANCE
A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed selective demolition Work similar to that indicated for this Project.
B. Regulatory Requirements: Comply with governing EPA notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.07 PROJECT CONDITIONS
A. Occupancy: Owner will occupy buildings immediately adjacent to alteration areas. Conduct alteration work in manner that will minimize need for disruption of Owner's operations. Provide minimum 72 hours advance notice to Owner of demolition activities that will affect Owner's operations.
B. Owner assumes no responsibility for actual condition of buildings to be altered.
   1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
C. Asbestos or Hazardous Waste: It is understood and agreed that this contract does not contemplate the handling of asbestos or any hazardous waste material except as done by a properly qualified subcontractor. If asbestos or any hazardous waste material is encountered, notify the Owner immediately. Do not disturb, handle or attempt to remove.
D. Traffic: Conduct demolition operations and debris removal in a manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
   1. Do not close, block or otherwise obstruct streets, walks or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

PART 2 - PRODUCTS

2.01 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING
A. Provide same products or types of construction as that in existing structure, as needed to patch, extend or match existing work.
   1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
   2. Use materials whose installed performance equals or surpasses that of existing materials.
   3. Generally Contract Documents will not define products or standards of workmanship present in existing construction; Contractor shall determine products by inspection and
any necessary testing, and workmanship by use of the existing as a sample of comparison.

B. Presence of a product, finish, or type of construction, requires that patching, extending or matching shall be performed as necessary to make work complete and consistent to identical standards of quality.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine existing conditions, including elements subject to movement or damage during remodeling work.

B. After uncovering the work, examine conditions affecting installation of new work.

C. Discrepancies:
   1. If uncovered conditions are not as anticipated, immediately notify the Architect and secure needed directions.
   2. Do not proceed in areas of discrepancy until such discrepancies have been fully resolved.

D. Time extensions or increase or decrease of costs resulting from such changes will be adjusted in the manner provided in the General Conditions.

3.02 UTILITY SERVICES

A. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.
   1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
   2. Provide not less than 72 hours notice to Owner if shutdown of service is required during changeover.

B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving building to be selectively demolished.
   1. Owner will arrange to shut off indicated utilities when requested by Contractor.
   2. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.
   3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit after bypassing.

C. Utility Requirements: Refer to Division 15 or 16 Sections for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.03 PREPARATION

A. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective demolition area.
   1. Erect temporary protection, such as walks, fences, railings, canopies, and covered
passageways, where required by authorities having jurisdiction.

2. Protect existing site improvements, appurtenances, and landscaping to remain.

3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

4. Provide temporary weather protection, during interval between demolition and removal of existing construction, on exterior surfaces and new construction to ensure that no water leakage occurs to structure or interior areas.

5. Protect walls, ceilings, floors, and other existing finish work that are to remain and are exposed during selective demolition operations.

B. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement or collapse of structures to be selectively demolished.

1. Cease operations and notify the Owner's Representative immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

2. Strengthen or add new supports when required during progress of selective demolition.

C. Cover and protect furniture, furnishings, equipment and fixtures that have not been removed.

D. Provide and maintain barricades and guard rails as required by applicable regulatory agency to protect occupants of building and workers.

E. Where demolition, removal or rework occurs, take all necessary precautions to protect finished work from damage. Finished work damaged by operations under this contract shall be repaired or replaced to the acceptance of Owner and Architect at no extra cost to the Owner.

F. Site Access and Temporary Controls: Conduct selective demolitions and debris. Remove operations to ensure minimum interference with roads, street, walk, bridges, balcony and other adjacent occupied and used facilities.

3.04 POLLUTION CONTROLS

A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before start of selective demolition.

3.05 SELECTIVE DEMOLITION, ALTERATIONS

A. Cut, drill, alter, remove, or temporarily remove and replace existing construction as necessary for performance of work under the contract. Work that is replaced shall match similar existing work.

B. Unless otherwise noted on the drawings or specified do not cut or alter structural members without authorization of the Architect or Structural Engineer.
C. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations.

1. Repair all demolition performed in excess of that required, at no cost to the Owner.

D. Work remaining in place which is damaged or defaced during this contract shall be restored to the condition at time of award of contract.

E. If removal of existing work exposes discolored or unfinished surfaces, or work out of alignment, refinish such surfaces or replace the material as necessary to make contiguous work uniform.

F. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

G. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

H. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

I. Maintain adequate ventilation when using cutting torches.

J. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

K. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

L. Locate selective demolition equipment throughout the structure and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

M. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.

N. Cut finish surfaces such as concrete, masonry, tile, plaster or metals, by methods to terminate surfaces in a straight line at a natural point of division.

O. Where new work joins existing construction, ensure that jointing is weather tight, sound and even in appearance.

P. Fixtures and outlets to be removed shall have their utility lines capped within walls or floors. Utility lines encountered in the work shall be capped, extended or reworked as necessary for completion of alterations.

3.06 PATCHING AND REPAIRS

A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations.

B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls to remain with an approved masonry patching material, applied according to manufacturer's printed recommendations.
C. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.

D. Patch and repair floor and wall surfaces in the new space where demolished walls or partitions extend one finished area into another. Provide a flush and even surface of uniform color and appearance.
   1. Closely match texture and finish of existing adjacent surface.
   2. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
   3. Where patching smooth painted surfaces, extend final paint coat over entire unbroken surface containing the patch after the surface has received primer and second coat.
   4. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   5. Inspect and test patched areas to demonstrate integrity of the installation, where feasible.

E. Patch, repair, or re-hang existing suspended ceilings as necessary to provide an even-plane surface of uniform appearance.

3.07 DISPOSITION OF MATERIALS

A. Promptly remove from the site all materials resulting from demolition and alteration which are not to be reused.

B. Do not allow demolished materials to accumulate on-site.

C. Burning of materials on site is not permitted.

D. Remove and transport debris in a manner that will prevent spillage on adjacent surface and areas.

E. Store items to be reused in a protected location until reinstallation.

F. Remove debris from all elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

G. Disposal: Transport demolished materials off Owner’s property and legally disposes of them.

3.08 SALVAGE OF MATERIALS

A. Work Performed by Owner: Prior to start of construction, Owner will do following work: Removal of moveable furniture and equipment.

B. Salvage by Contractor for Owner’s Use: Contractor shall salvage, by removing in good condition, and stock piling as directed, on the site, for Owner warehousing, following items not incorporated in new work: Electric panels, Novar control systems and finish door hardware.

C. Salvage by Contractor for his Own Use: Contractor may remove for his own salvage the balance of materials not claimed by the Owner.

3.09 CLEAN-UP AND REPAIR

A. Perform periodic and final cleaning.

B. Upon completion of alteration work, remove tools, equipment and demolished materials from site. Remove protections and leave interior areas broom clean.

C. Clean adjacent structures and improvements of dust, dirt and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

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D. Upon completion of alteration work, change filter on air-handling equipment.

END OF SECTION
SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section Includes: Provision of light-gauge steel stud and joist framing. Work includes, but is not necessarily limited to the following:
   1. Load-bearing steel stud framing at exterior walls.
   2. Interior stud wall and ceiling framing with studs 18-gauge and heavier.
   3. Framing accessories.

B. Related Sections:
   1. Metal Support Assemblies: Section 09 22 00.
   2. Gypsum Board: Section 09 23 00.

1.02 REFERENCES

A. Requirements of the GENERAL CONDITIONS and DIVISION NO. 1 apply to all Work in this Section.

B. Published specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work of this Section where cited by abbreviations noted below (latest editions apply).
   5. American Iron and Steel Institute (AISI): “Specifications for the Design of Cold-Formed Steel Structural Members”.
   6. Metal Stud Manufacturer’s Association (MSMA).
   7. Metal Lath Association (MLA): “Specifications for Metal Lath and Furring”.
   8. Steel Structures Painting Council (SSPC): “Painting Manual”.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with fire-resistance ratings as indicated and as required by governing authorities and codes.
   2. Provide materials, accessories, and application procedures which have been listed by an approved testing agency or tested according to ASTM E119 for the type of construction shown.
   3. Comply with CBC Section 2210A.4 and AISI requirements for design and identification of cold-formed steel.
   4. Framing system shall conform to ICC-ES Report for stud gauge and spacing for all wall conditions.

B. Steel stud system shall conform to referenced AISI documents.

C. Installer: Company specializing in performing the work of this Section with minimum 3 years' documented experience.
D. Welders: Qualified in accordance with AWS D1.3 for welding process, position, type of weld and type of steel.

1.04 SUBMITTALS

A. Shop Drawings: Include plans and elevations at not less than 1/4-inch to 1'-0" scale, and details at not less than 3-inches to 1'-0" scale.
   1. Indicate wall stud and ceiling joist layout.
   2. Indicate component details, framed openings, bearing, anchorage to structure, type and location of fasteners and accessories, and items required of related work for complete installation of steel stud system.

B. Product Data: Manufacturer's ICC ER report, specifications and installation instructions for steel studs, fasteners, and accessories.

C. Experience of installer if requested by Architect.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect framing from rusting and damage.

B. Deliver in manufacturer's unopened containers or bundles fully identified with name, brand, type and grade.

C. Store inside a dry, ventilated space, and protect framing from rust and damage.

1.06 JOB CONDITIONS

A. Coordinate stud sizes and layouts with the work of the various trades. Where ductwork, conduit, piping, casework, and other such items exceed indicated available space, increase stud sizes or make other minor modifications as necessary to accommodate the work at no change in cost of the Work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

   Refer to drawings.

2.02 MATERIALS

A. Sheet Steel: ASTM A570, Grade 50.

B. Studs: C-studs with punched web, unless otherwise noted, formed of gauge as specified on the Drawings.
   1. Provide ASTM A570, Grade 50 and 33 as noted, shop-coat with manufacturer's standard rust-inhibitive primer after fabrication.
   2. Minimum properties for each size stud shall be as indicated on Drawings.

C. Floor Tracks: Formed from same gauge and grade of steel as used for studs: 1-1/4-inch legs.
   1. Provide ASTM A653, Grade D, or shop-coat with rust-inhibitive primer after fabrication.

D. Ceiling Tracks: Formed from 16-gauge steel, 2-inch legs or as indicated on the Dwg.
1. Provide ASTM A653, Grade D, or shop-coat with rust-inhibitive primer after fabrication.

E. Deflection Tracks: Manufacturer’s standard top runner designed to prevent cracking of gypsum board applied to interior partitions resulting from deflection of the structure above fabricated from steel sheet complying with ASTM A653 or ASTM A668. Thickness as indicated for studs and width to accommodate depth of studs and of the following configuration:
   1. Top Runner with Slotted Flanges: 2-1/2 inch deep flanges with slots 1 inch on center.
   2. Product: Sliptrack Systems, or approved equal.

F. Cold-Rolled Furring Channels: As specified in Section 09 22 00, "Metal Support Assemblies".

G. Partition Stiffeners or Bridging: Unpunched channel shape, formed of 16-gauge steel to required dimensions.

H. Power-Driven Fasteners: As indicated on the Drawings. Metal Fasteners as indicated on the Drawings.

I. Expansion Bolts: as indicated on the Drawings. Metal Fasteners or as indicated on the Drawings.

I. Welding Electrodes: AWS low hydrogen, rod number and diameter as approved by the Owner’s Testing Agency.

J. Bracing: Provide cross diagonal 3-inch wide by 14-gauge straps, welded as indicated on the Drawings and per stud manufacturer’s specifications for frame stability.

K. Touch-up Primer for Galvanized Surfaces: SSPC Paint 20 zinc rich.

L. Metal Screws: As indicated on the Drawings. Metal Fasteners or as indicated on the Drawings.

M. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

N. Metal Backing Plates: As indicated on drawings.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate details and requirements of other Work which adjoins or fastens to studs and requires backing or special support framing included in this Section.
   1. Items requiring backing or support include, but are not necessarily limited to casework, wall-specialties, and similar items.
   2. Obtain Architect’s approval of backing method proposed to satisfy requirements of this Section which differs from methods noted or shown.

3.02 EXAMINATION

A. Examine all parts of the supporting structure and the conditions under which studs will be installed.

B. Notify the Architect, in writing, of any conditions detrimental to the proper and timely completion of the Work.

C. Do not proceed with the installation of steel studs until unsatisfactory conditions have been corrected.
3.03 INSTALLATION

A. Tracks shall be securely anchored to supporting structure, with fasteners specified at not more than 24-inches on center.

B. Complete, uniform, and level bearing support shall be provided for the bottom track at each bearing-stud location. Install full metal shims below bottom track at stud locations as needed or set bottom track in high-strength grout.

C. Abutting or intersecting pieces of track shall be securely anchored to a common structural element or spliced together.
   1. Splices or butt welds shall be used at all butt joints in the runner track.
   2. Do not splice studs.

D. Framed wall openings shall include a header and multiple studs at each edge of opening as indicated on Drawings.

E. Diagonal bracing shall be installed at locations indicated for frame stability.

F. Install bridging as indicated on Drawings.

G. Form corners and intersections of partitions with three studs. Provide additional studs as indicated or required.

H. Connections of members shall be made with welding or sheet metal screws; wire tying of framing members shall not be permitted.

I. Wire tying of framing members shall not be permitted.

J. Welded connections shall be made by resistance spot fusion welding, fillet welding, or plug welding and shall be done in accordance with the latest recommended procedures and practices of the American Welding Society.

K. Do not cut or notch stud flanges or cut additional opening in stud web.

L. Field abrasions and welds shall be touched up with zinc rich primer.

M. Tolerance: Install members to provide surface plane with maximum variation of 1/8-inch in 10-feet in any direction. Space individual framing members no more than plus or minus 1/8-inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

N. Provide all angles, clips and other miscellaneous pieces necessary to attach light gauge framing to building structure or to attach other materials to light gauge framing.

3.04 INSTALLATION OF FIRE-RATED ASSEMBLIES

A. Install studs which are components of fire-rated wall assemblies as indicated.

3.05 BACKING IN STUD PARTITIONS

A. Securely weld or screw cut sections of unpunched stud to at least three stud or furring supports, leaving flat surface of backing stud web to receive attachment of object to be secured.

B. Verify that any pre-drilling of backing and attachment of spacers to prevent crushing of collateral material is done prior to application of collateral material.

C. If it is determined by the Architect that backing was not provided for any items as required, the Contractor shall remove the finish material and install backing. The Contractor shall patch and refinish surface to match adjacent area and finish.

3.06 FIELD QUALITY CONTROL
A. The Owner’s Testing Agency will:
   1. Provide continuous inspection of welding, including prior fit-up, welding equipment, weld quality, and welder certification in accordance with AWS and CBC Section 1701A.5.
   2. Provide continuous inspection during installation as required to establish conformity of Work requirements.

3.07 ERECTION TOLERANCES
   A. Maximum Variation from True Position: ¼-inch.
   B. Maximum Variation of any Member from Plane: ¼-inch.

END OF SECTION
SECTION 06 16 43

GYPSUM SHEATHING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Fiberglass-mat faced, moisture and mold resistant gypsum sheathing.

B. Related Sections:
   1. Section 05 40 00 Cold-Formed Metal Framing
   2. Section 09 23 00 Gypsum Board.

1.02 REFERENCES

A. ASTM International (ASTM):
   3. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
      10. ASTM C1396 Standard Specification for Gypsum Board


1.03 SUBMITTALS

A. Product Data: Manufacturer’s specifications and installation instructions for each product specified.

1.04 WARRANTY

A. Provide products that offer twelve months of coverage against in-place exposure damage (delamination, deterioration and decay) commencing with the date of installation of the product in such structure.
B. Manufacturer's Warranty:
1. Five years against manufacturing defects from the date of purchase of the product for installation
2. 12 years against manufacturing defects when used as a substrate in architecturally specified EIFS.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Georgia-Pacific Gypsum LLC:
   2. Fiberglass-Mat Faced Gypsum Sheathing, Type X for Fire Rated Designs: DensGlass Fireguard Sheathing.

2.02 MATERIALS

A. Fiberglass-Mat Faced Gypsum Sheathing: ASTM C1177:
   1. Thickness: 5/8 inch.
   2. Width: 4 feet.
   3. Length: [8 feet] [9 feet] [10 feet].
   4. Weight: 1.9 lb/sq. ft.
   5. Edges: Square.
   6. Surfacing: Fiberglass mat on face, back, and long edges.
   7. Racking Strength (Ultimate, not design value) (ASTM E72): Not less than 540 pounds per square foot, dry.
   11. R-Value (ASTM C518): 0.56.
   14. Acceptable Products:
      a. 5/8 inch DensGlass Sheathing, Georgia-Pacific Gypsum LLC.

B. Fire-Rated Fiberglass-Mat Faced Gypsum Sheathing: ASTM C1177, Type X:
   1. Thickness: 5/8 inch.
   2. Width: 4 feet.
   3. Length: [8 feet] [9 feet] [10 feet].
   4. Weight: 2.5 lb/sq. ft.
   5. Edges: Square.
   6. Surfacing: Fiberglass mat on face, back, and long edges.
   7. Racking Strength (Ultimate, not design value) (ASTM E72): Not less than 654 pounds per square foot, dry.
   14. Acceptable Products:
2.03 ACCESSORIES

A. Screws: ASTM C1002, corrosion resistant treated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
   1. Inspection: Verify that project conditions and substrates are acceptable, to the installer, to begin installation of work of this section.

3.02 INSTALLATION

A. General: In accordance with GA-253, ASTM C1280 and the manufacturer’s recommendations.

   1. Manufacturer’s Recommendations:

3.03 PROTECTION

A. Protect gypsum board installations from damage and deterioration until date of Substantial Completion.

END OF SECTION
SECTION 07 21 00

THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Batt insulation in exterior wall construction.

B. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

C. Rigid insulation at exterior wall construction as shown on Drawings.

1.02 RELATED REQUIREMENTS

A. Section 05 40 00 – Cold-Formed Metal Framing: Board insulation as wall sheathing.

B. Section 09 22 00 – Metal Support Assemblies: Acoustic insulation inside walls and ceilings.

1.03 REFERENCE STANDARDS


1.04 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. Manufacturer’s Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

D. Manufacturer’s Certificate: Certify that products meet or exceed specified requirements.

E. Samples: Provide two 12 by 16 inch samples of acoustical insulation representing actual product, color, and patterns.

1.05 FIELD CONDITIONS

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

1.06 SEQUENCING

A. Sequence work to ensure fireproofing and firestop materials are in place before beginning work of this section.
PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation over Metal Stud Framed Walls, Continuous: polyisocyanurate board.
B. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.
C. Insulation in Metal Framed Ceiling Structure: Batt insulation with no vapor retarder.

2.02 RIGID INSULATION MATERIALS

A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289; Type I, aluminum foil both faces; Class 2, glass fiber-reinforced core.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Compressive Strength: 16 psi
   4. Board Size: 48 x 96 inch and 48 x 144 inch.
   5. Board Thickness: 1 inch.
   7. Manufacturers:
   8. Substitutions: See Section 01625 - Product Options and Substitutions.

2.03 BATT INSULATION MATERIALS

A. Unfaced Thermal Batt Insulation in walls: ASTM C 665; preformed batt; friction fit, conforming to the following:
   1. Material: Textile-type fiberglass insulation with long-spun fibers.
   2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E 84.
   3. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E 84.
   4. Combustibility: Non-combustible, when tested in accordance with ASTM E 136.
   5. Formaldehyde Content: Zero.
   8. Recycle Content: 85% Pre-Post-Consumer products.
   9. Manufacturers:
      b. Following manufacturer's are acceptable provided they meet the requirements above.
      c. Substitutions: See Section 01625 - Product Options and Substitutions.

2.04 ACCESSORIES

A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.
B. Weathermate flashing for seams in rigid board insulation.
C. Wire Mesh: Galvanized steel, hexagonal wire mesh.
D. Adhesive: Type recommended by insulation manufacturer for application.
PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT EXTERIOR WALLS
A. Adhere a 6 inch wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints between sheets.
   2. Extend sheet full height of joint.
B. Apply adhesive to back of boards:
   1. Full bed 1/8 inch thick.
C. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and to protrusions.
D. Extend boards over expansion joints, unbonded to wall on one side of joint.
E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
F. Tape insulation board joints with flashing.

3.03 THERMAL BATT INSTALLATION
A. Install insulation in accordance with manufacturer’s instructions.
B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
E. Retain insulation batts in place with wire mesh secured to framing members.

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

END OF SECTION
SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

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

1.02 SECTION INCLUDES
   A. Sealants and joint backing.
   B. Precompressed foam sealers.
   C. Hollow gaskets.

1.03 PERFORMANCE REQUIREMENTS
   A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous
      joint seals without staining or deteriorating joint substrates.

1.04 REFERENCES
      (Closed-Cell); 2005.
   G. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition;
      www.aqmd.gov.

1.05 SUBMITTALS
   A. See Section 01 33 00 – Submittals for submittal procedures.
   B. Product Data: For each joint-sealant product indicated. Include manufacturer’s installation
      instruction.
   C. Samples: Submit two samples, illustrating sealant colors for selection.
   D. Qualification Data: For Installer.
   E. Warranties: Special warranties specified in this Section.

1.06 QUALITY ASSURANCE
   A. Installer Qualifications: Manufacturer’s authorized Installer who is approved or licensed for
      installation of sealants required for this Project, with minimum three years experience.
B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

D. Maintain one copy of each reference document covering installation requirements on site.

1.07 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.08 WARRANTY

A. See Section 01 77 10 – Closeout Procedures for additional warranty requirements.

B. Special Installer’s Warranty: Installer’s standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.02 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

2.03 JOINT SEALANTS

A. Type SJ-1 - General Purpose Exterior Sealant: Polyurethane; ASTM C 920, Grade NS, Class 25, Uses M, G, and A; single component.
   3. Applications: Use for:
      a. Control, expansion, and soft joints in masonry.
      b. Joints between concrete and other materials.
      c. Joints between metal frames and other materials.
      d. Other exterior joints for which no other sealant is indicated.

C. Type SJ-2 - Exterior Expansion Joint Sealer: Pre-compressed foam sealer; urethane with water-repellent;
   2. Size as required to provide weathertight seal when installed.
3. Provide product recommended by manufacturer for traffic-bearing use.
5. Applications: Use for:
   a. Exterior wall expansion joints.

D. Type SJ-3 - Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, nondrying, nonskinning, noncuring.
   1. Product: Butyl Sealant manufactured by Tremco.
   2. Applications: Use for:
      a. Concealed sealant bead in sheet metal work.
      b. Concealed sealant bead in siding overlaps.

E. Type SJ-4 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C 834, Type OP,
   Grade NF single component, paintable.
   3. Applications: Use for:
      a. Interior wall and ceiling control joints.
      b. Joints between door and window frames and wall surfaces.
      c. Other interior joints for which no other type of sealant is indicated.

F. Type SJ-5 - Bathtub/Tile Sealant: White silicone; ASTM C 920, Uses I, M and A; single compo-
   nent, mildew resistant.
   1. Product: Tremsil 200 with fungicide manufactured by Tremco.
   2. Applications: Use for:
      a. Joints between plumbing fixtures and floor and wall surfaces.
      b. Joints between kitchen and bath countertops and wall surfaces.

G. Type SJ-6 - Acoustical Sealant: Synthetic rubber sealant; ASTM D 217, Grade NS, Class 12-1/2,
   Uses M and A; single component, solvent release curing, non-skimming.
   1. Acoustical sealant shall be non-skinning, non-hardening, flexible sealant specifically
designed for sealing gypsum wallboard. Sealant shall be capable to spanning ½ inch wide
by 3/8 inch deep gaps. Synthetic rubber based products shall comply with ASTM D217
and acrylic latex based products shall comply with ASTM C834.
   3. Applications: Use for concealed locations only:
      a. Sealant bead between top stud runner and structure and between bottom stud track
         and floor.

H. Type SJ-7 - Interior Floor Joint Sealant: Polyurethane, self-leveling; ASTM C 920, Grade P,
   Class 25, Uses T, M and A; single component.
   1. Approved by manufacturer for wide joints up to 1-1/2 inches.
   4. Applications: Use for:
      a. Expansion joints in floors.

I. Type SJ-8 - Silicone Sealant: ASTM C 920, Grade NS, Class 25, Uses NT, A, G, M, O; single
   component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding.
   4. Service Temperature Range: -65 to 180 degrees F.
   5. Shore A Hardness Range: 15 to 35.
   6. Applications: Use for:
      a. Glass.
2.04 ACCESSORIES
A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
E. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
B. Proceed with installation only after unsatisfactory conditions have been corrected.
C. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION
A. Perform preparation in accordance with manufacturer's instruction and ASTM 1193.
B. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
      a. Concrete.
      b. Masonry.
C. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Protect elements surrounding the work of this section from damage or disfigurement.
D. Joint Priming: Prime joint substrates based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
E. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning
methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer’s written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Perform acoustical sealant application work in accordance with ASTM C 919.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
   4. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
   5. Tool joints concave.

E. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
   3. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
   4. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.

D. Install bond breaker where joint backing is not used.

E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Pre-compressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

G. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

3.04 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
   1. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.

B. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
3.05 CLEANING
A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION
A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.06 JOINT SEALANT SCHEDULE
A. Exterior Joints for Which No Other Sealant Type is Indicated: Type SJ-1; colors as selected.
B. Control and Expansion Joints in Paving: Type SJ-2.
C. Control, Expansion, and Soft Joints in Masonry, and Between Masonry and Adjacent Work: Type SJ-1.
D. Lap Joints in Exterior Sheet Metal Work: Type SJ-3.
E. Joints between Exterior Metal Frames and Adjacent Work (except masonry): Type SJ-1.
F. Under Exterior Door Thresholds: Type SJ-1.
G. Interior Joints for Which No Other Sealant is Indicated: Type SJ-4; colors as selected.
H. Control and Expansion Joints in Interior Concrete Slabs and Floors: Type SJ-7.
I. Joints between Plumbing Fixtures and Walls and Floors, and Between Countertops and Walls: Type SJ-5.
J. In STC-Rated Walls, Between Metal Stud Track/Runner and Adjacent Construction: Type SJ-6.
K. Glass to aluminum joints: Type SJ-8; color as selected from manufacturer's standard colors.

END OF SECTION
SECTION 08 13 00

STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
   1. Provision of fire-rated and non-fire rated flush steel doors for interior locations.
   2. Provision of steel frames for interior doors and windows.

B. Products Installed but not Furnished Under this Section
   1. Section 08 71 00 - Door Hardware: Furnishing of finish hardware.

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

D. Related Sections
   1. Section 08 14 16 - Flush Wood Doors: Provision of flush wood doors.
   3. Section 09 22 00 - Metal Support Assemblies: Provision of metal framing.
   4. Section 09 90 00 - Painting and Coating: For field painting primed doors and frames.

1.02 REFERENCES

A. ANSI - American National Standards Institute
   1. ANSI/UL 10B Fire Tests of Door Assemblies
   2. ANSI/NFPA 80 Standards for Fire Doors and Fire Windows
   3. ANSI/NFPA252 Fire Tests of Door Assemblies
   4. ANSI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
   5. ANSI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing
   6. ANSI A250.6 (SDI 107) - Hardware on Standard Steel Doors (Reinforcement-Application)
   7. ANSI A250.7 - Nomenclature for Steel Doors and Steel Door Frames
   8. ANSI A250.8 (SDI-100) - Recommended Specifications for Steel Doors & Frames
   9. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
   10. ANSI/DHI A115 Specifications for Hardware Preparations in Standard Steel Doors and Frames

B. ASTM - American Society for Testing and Materials

C. DHI - Door and Hardware Institute
   1. RL - Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames.

D. Fire Protection
   1. UL 10B Fire Tests of Door Assemblies (Neutral test pressure)
   2. UL 10C Standard for Safety for Positive Pressure Fire Tests of Door Assemblies
   3. NFPA 252 Fire Tests of Door Assemblies (Neutral test pressure)
   4. UBC 7-2-1997 Positive Pressure Fire Tests of Door Assemblies
   5. NFPA 80 Standard for Fire Doors and Fire Windows

E. SDI - Steel Door Institute
   1. SDI 105 - Recommended Erection Instructions for Steel Frames
   2. SDI 106 - Recommended Standard Door Type Nomenclature
   3. SDI 108 - Recommended Selection and Usage Guide for Standard Steel Doors
   4. SDI 109 - Hardware for Standard Steel Doors & Frames
   5. SDI 110 - Standard Steel Doors & Frames for Modular Masonry Construction
   6. SDI 111 - Recommended Standard Details for Steel Doors and Frames
   7. SDI 112 - Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors & Frames
   8. SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames
   9. SDI 124 - Maintenance of Standard Steel Doors and Frames

F. UL - Underwriters Laboratories, Inc.

1.03 SUBMITTALS

A. Product Data: Submit product data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles and finishes, and manufacturer's installation instructions.

B. Shop Drawings: Submit shop drawings showing fabrication and installation of standard steel doors and frames referenced to the Architect's door mark and hardware group. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
   1. Provide schedule of doors and frames using same reference numbers for details and openings as those on the Contract Drawings.
   2. Indicate coordinate of glazing frames and stops with glass and glazing requirements.

1.04 QUALITY ASSURANCE

A. Conform to requirements of ANSI A250.8-1998 (SDI-100), ANSI A151.1, and other specifications herein named. Test reports shall be submitted upon request.

B. Acoustical qualities: Doors shall have a minimum sound transmission classification of 28 as tested under ASTM designation E490 and ASTM designation E413.

C. Insulation properties: Doors shall have a U factor .363 (R factor of 2.85) for honeycomb
core. U factor for polystyrene core of .263 (R factor of 3.8), U factor for polyurethane core of 0.09 (R factor of 11.1).

D. Underwriters' Laboratories and Warnock Hersey, labeled fire doors and frames:
1. All labeled fire doors and frames shall be of a type which has been investigated and tested in accordance with either UL-10(b), ASTM E-152, NFPA 252, ANSI A2.2, or UL-10(c), UBC 7-2-1997.
2. Underwriters' Laboratories labeled doors and frames shall be manufactured under the UL factory inspection program and in strict compliance to UL procedures, and shall provide the degree of fire protection, heat transmission and panic loading capability indicated by the opening class.
3. Warnock Hersey labeled doors and frames shall be manufactured to meet the specific requirements of that labeling agency's current procedure for the tested hourly rating designated and shall be subject to inspection by representatives of the labeling agency.
4. A physical label or approved marking shall be affixed to the fire door or fire door frame, at an authorized facility as evidence of compliance with procedures of the labeling agency.

1.05 REGULATORY REQUIREMENTS

A. Provide fire rated door assemblies that comply with NFPA 80, are identical to door and frame assemblies whose fire resistance characteristics have been determined in accordance with ASTM E152 and which are labeled and listed by UL or Intertek Testing Agency.

B. Oversized Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide manufacturer's certification that doors conform to standard construction requirements of tested and labeled doors for rated door assemblies except for size.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site
1. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage.
2. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to the Architect; otherwise, remove and replace damaged items as directed.

B. Storage and Protection: Store doors and frames at building site under cover. Doors shall be stored in an upright position. Place units on minimum 4 inches high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inch spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Steelcraft Manufacturing Co., Curries, Republic Builders Products or equal.

2.02 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A569 and ASTM A568.
B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A366 and ASTM A568.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A526, or drawing quality, ASTM A642, hot dipped galvanized in accordance with ASTM A625 with A60 or G60 coating designation, mil phosphatized.

D. Supports and Anchors: Fabricate of not less than 18 gauge sheet steel; galvanized where used with galvanized frames.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built in at exterior walls, hot-dip galvanize in compliance with ASTM A153, Class C or D as applicable.

F. Shop Applied Paint: Apply after fabrication.
   1. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A250.10 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames".

G. Finish: As specified in Section 09900 and refer to Door Schedule Sheet 8.01.

2.03 DOORS

A. Provide metal doors of SDI grades and models specified below or as indicated on the Drawings or schedules:
   1. Interior Doors: Provide doors complying with requirements indicated below by referencing ANSI 250.8 for level and model and ANSI A250.4 for physical endurance level:
      a. Level 1 and Physical Performance Level C, (Standard Duty), Model 1 (Full Flush).
      b. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
      c. Interior doors shall be 18 gauge commercial quality carbon steel.
   2. Exterior Doors (as occurs): Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
      a. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).
   3. Door Louvers (as occurs): Provide sightproof stationary louvers for interior doors where indicated, constructed of inverted V-shaped or Y-shaped blades formed of 24 gauge cold-rolled steel set into minimum 20 gauge steel frame.

B. Construction of Doors:
   1. Laminated core doors
   2. L-Series Doors shall be full-flush or full-flush seamless construction, fabricated from commercial quality carbon steel or hot-dipped galvannealed steel (see Section 2.02) 18 gauge for 1-3/4" doors. Doors shall be reinforced, sound deadened and insulated with impregnated Kraft honeycomb core completely filling the inside of the doors and laminated to inside faces of both panels using contact adhesive applied to both panels and honeycomb core.
   3. Door shall have continuous vertical mechanical interlocking joints at lock and hinge edges with visible edge seams or with edge seam filled and ground smooth. The internal portion of the seam shall be sealed with epoxy. An intermittent fastening along the seam is not permitted. Doors shall have beveled (1/8" in 2") hinge and lock edges. Top and bottom steel reinforcement channels shall be galvannealed 14 gauge and projection welded to both panels.
   4. Hinge reinforcements shall be 7 gauge for 1-3/4" doors. Lock reinforcements shall be 16 gage and closer reinforcements 14 gage box minimum 6" high and 20" long. Hinge and lock reinforcements shall be projection welded to the edge of the door. Galvannealed doors shall have galvannealed hardware reinforcements. Adequate
reinforcements shall be provided for other hardware as required.

5. Glass trim for doors with cutouts shall be 24 gage steel conforming to ASTM designation A 924 hot dipped galvannealed steel with a zinc coating of 0.06 ounces per square foot. The trim shall be installed into the door as a four sided welded assembly. The trim shall fit into a formed area of the door face, shall not extend beyond the door face and shall interlock into the recessed area. The corners of the assembly shall be mitered, reinforced and welded. The trim shall be the same on both sides of the door. Exposed fasteners shall not be permitted. Label and non-label doors shall use the same trim.

6. Doors indicating divided glass lites shall be made using a door with a cutout and trim for one piece of glass. The small lites shall be created by an extruded aluminum grille work mechanically fastened to the glass lite trim on both sides of the door. The grille work sections shall be beveled on the exposed side and shall have a flange on the unexposed side to which glazing tape can be applied. The grille work shall be installed into both sets of glass trim prior to installing into the door. One glass trim and muntin assembly shall be installed into the door prior to glazing. After glazing the other glass trim and muntin assembly shall be installed into the door.

7. All exterior out swing doors shall have the tops closed to eliminate moisture penetration. Door tops shall have no holes or openings. Top caps are permitted.

8. Fire Resistive: Labeled door core material shall conform to requirements of labeling authority.

2.04 FRAMES

A. Provide metal frames for doors and windows of types and styles as indicated on the Drawings and schedules. Conceal fastenings, unless otherwise indicated.
   1. Interior: Fabricate fully welded frames of minimum 16 gauge commercial quality carbon steel.
   2. Exterior: Fabricate fully welded frames of minimum 16 gauge hot dipped galvannealed steel.

B. Construction Frames:
   1. Flush Frames
      a. F-Series flush frames shall be formed from 16 commercial quality carbon steel or galvannealed steel (see Section 2.01).
      b. F-Series frames shall have 2" faces, FN-Series frames shall have 1" faces. F16 gauge frames shall be set-up and back welded with full penetration through to the face, ground down and smoothed. Miter corners shall have reinforcements with four concealed integral tabs for secure and easy interlocking of jambs to head.
      c. Frames for 1-3/4" doors shall have 7 gauge universal steel hinge reinforcements prepared for 4-1/2" x 4-1/2" standard or heavy weight template hinges. Strike reinforcements shall be 16 gauge and prepared for an ANSI-A115.1-2 strike.
      d. Steel plaster guards shall be provided for all mortised cutouts. All hinge and strike reinforcements shall be projection welded to the door frame. Reinforcements for surface applied door closers shall be 14 gauge steel.
      e. Galvannealed frames shall have galvannealed hardware reinforcements. Adequate reinforcements shall be provided for other hardware when required. F-Series frames shall be furnished with a minimum of six wall anchors and two adjustable base anchors of manufacturer’s standard design. FN-Series frames shall be furnished with a minimum of six wall anchors and two fixed base anchors.
         1) Steel plaster guards shall be provided for all mortised cutouts.
         2) All hinge and strike reinforcements shall be projection welded to the door frame.
         3) Reinforcements for surface closer shall be 14 gauge steel. Adequate

STEEL DOORS AND FRAMES
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reinforcements shall be provided for other hardware when specified.
4) Galvannealed frames shall have galvannealed hardware reinforcements.

2. Drywall Frames
   a. DW and K-Series drywall frames shall be formed from 18 or 16 gauge commercial quality carbon steel or galvannealed steel. DW and K-Series frames shall be formed with double return backbends to prevent cutting into the drywall surface. Frames shall be knocked down, designed to be securely installed in the rough opening after wallboard is applied. Mitered corners shall be reinforced with a wedge lock corner clip to provide a firm interlock of jambs to head.
   b. Frames for 1-3/4" doors shall have 7 gauge steel hinge reinforcements and preparation for 4-1/2" x 4-1/2" standard weight template hinges. Strike jamb shall have 16 gauge strike reinforcement and preparation for ANSI A115.1-2 strike. Strike jamb shall have 14 gauge reinforcement and preparation for ANSI A115.3 strike.
   c. Each jamb shall have an adjustable compression anchor located 4" from the top of the door opening to hold the frame in rigid alignment. DW-Series frames shall have a welded-in base anchor attaching plate in each jamb for field installation of loose base anchors. K-Series frames shall have a dimpled hole in each face, near the bottom of each jamb for screw anchoring the base of frame to the wall construction.

3. Construction of Architectural Stick Components
   a. Architectural stick frame assemblies shall be made of standard frame components, manufactured from 16 gauge or 14 gauge commercial quality carbon steel or galvannealed steel. Where sticks are used at door openings and frame assemblies, they shall be prepared for hardware as specified. Frame assemblies shall be fabricated from three basic components:
       1) Open sections (perimeter members), closed sections (intermediate members), and sill sections.
       2) Open sections shall be identical in configuration to Steelcraft standard frames.
       3) Closed sections shall have identical jamb depths, face dimensions and stops as open sections. Closed sections shall be factory assembled and shall have full length internal reinforcement of 16 gage steel, factory spot-welded to both soffits at 8" on center.
       4) Sill sections shall be fabricated from galvannealed steel and shall be either flush with both faces of adjacent vertical members or recessed from one face of the adjacent vertical members.
   b. Individual components shall be cut to length and notched to assure square joints and corners. All joints and corners of the frame assembly shall be welded and ground smooth at the face of the sections. Frame assemblies shall be shipped to job site completely welded. Field joints shall be permitted only when the size of the total assembly exceeds shipping limitations. When frame assemblies are subjected to windloads, vertical members shall be free of field splices.
   c. When specified, steel panels shall be furnished 3/8" or 1-3/4" thick as required. 3/8" panels shall be made of 18 gauge cold-rolled steel faces with a corrugated fiberboard filler. 1-3/4" panels shall be made of 20 gauge cold-rolled steel faces with a honeycomb core. Cores shall be laminated to inside faces of both panels. Stick components and panels shall be furnished as specified in Section 2.02. Steel channel glazing beads shall be provided with assemblies for all areas in which glass or panels are to be installed and shall be pierced and dimpled for oval head sheet metal screws.
   d. All necessary anchors for jambs, heads and sills of assemblies shall be provided. When verification of field dimensions is necessary, they shall be made by the
contractor. Frame fabrication shall not begin until these dimensions have been submitted.

C. Hardware:
1. As specified in Section 08710.
2. Door Silencers: Except on weatherstripped and smoke gasketed frames, drill stops to receive 3 silencers on strike jams of single door frames and 2 silencers on heads of double door frames.

D. Glass and Glazing: As specified in Sections 08 80 00.
1. At interior sound-rated windows, provide laminated glass as specified in Section 08 80 00.
2. Vision Lites shall be as indicated on the drawings; moldings shall be manufacturer’s standard.

E. PROTECTION COATINGS
1. The inside of all frames shall be fully grouted or, when an anti-freeze agent is used, shall be coated with a fibered asphalt coating prior to grouting. Coating shall be field applied by the contractor to a minimum 1/16” thickness.

2.04 FABRICATION

A. Frames shall be supplied
1. Knocked-down for field assembly for interior doors only with Architect’s prior approval.
2. Set up and welded with faces welded and ground smooth. Miters of frames shall be back welded. Weld shall penetrate the outside face. Faces shall be dressed smooth and prime painted. Filler materials are not permitted.

B. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer’s plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at Project site. Comply with SDI 100 requirements.
1. Internal Construction: Manufacturer’s standard vertical steel stiffeners or unitized steel grid with internal sound deadener on inside of face sheets in accordance with SDI standards.
2. Clearances: Not more than 1/8-inch at jambs and heads except between non-fire rated pairs of doors not more than 1/4-inch. Not more than 3/4-inch at bottom.

C. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel.

D. Tolerances: Comply with SDI 117.

E. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel.

F. Fabricate exterior doors, panels and frames from galvanized sheet steel in accordance with SDI 112. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 14 gauge inverted steel channels.

G. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

H. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 Series Specifications for door and frame preparation for hardware.
1. For concealed overhead door closers, provide space, cutouts, reinforcing and provisions for fastening in top rail of doors or head of frames, as applicable.
I. Reinforce doors and frames to receive surface applied hardware. Drilling and tapping for surface applied hardware may be done at Project site.

J. Locate hardware as indicated on final shop drawings or, if not indicated, in accordance with DHI RL.

K. Shop Painting: Clean, treat and paint exposed surfaces of steel door and frame units, including galvanized surfaces.
   1. Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before application of paint.
   2. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

L. Glazing Stops: Minimum 20 gauge steel.
   1. Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers and other panels in doors.
   2. Provide screw applied removable glazing beads on inside of glass, louvers, and other panels in doors.

2.05 FINISHES

A. Finish Painting: As specified in Section 09 90 00 and as noted on Door Schedule

B. All doors, frames and frame components shall be cleaned, phosphatized and finished as standard with one coat of rust inhibiting prime paint in accordance with the ANSI A250.10 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames".

C. Factory finish painted doors and frames shall be cleaned, phosphatized and finished with rust inhibiting paint capable of passing a 200-hour salt spray and 480-hour humidity test in accordance with ASTM designation B117 and ASTM designation D1735. Finish paint shall be in accordance with ANSI/SDI A250.3, "Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames".

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.

B. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated.
   1. Except for frames located at existing concrete, masonry or drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
   2. Install fire rated frames in accordance with NFPA Standard No. 80.
   3. In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In closed steel stud partitions, attach wall anchors to studs with screws.

C. Door Installation: Fit hollow metal doors accurately in frames, within clearances specified in SDI 100.
   1. Install fire rated doors with clearances as specified in NFPA Standard No. 80.

D. Sound-Rated Assemblies
   1. Install in accordance with manufacturer's instructions and under manufacturer's supervision.

STEEL DOORS AND FRAMES
08 13 00-8
2. Seal the shim space around frames airtight and in a manner consistent with the STC rating as indicated on the Drawings.

3. Sound-rated assemblies may be selected for in situ verification testing of the acoustical performance in accordance with ASTM E336. Contractor shall remedy all defects.

E. Fire-Rated Assemblies
   1. Label doors and frames shall be installed per NFPA-80 and/or as noted in item number 3.01A.

3.02 ERECTION TOLERANCES
   A. Clearances Between Door and Frame: As specified in ANSI A250.8.
   B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.03 ADJUST AND CLEAN
   A. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
   B. Final Adjustments: Check and readjust operating hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.
      1. Adjust for smooth and balanced door movement.
      2. Adjust sound control doors so that seals are fully engaged when door is closed.
      3. Test sound control doors for force to close, latch, and unlatch in accordance with ASTM E 1408; adjust as required to comply.

END OF SECTION
SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 SUMMARY
   A. Section Includes: Provision of fire rated and non-fire rated flush solid core doors with wood
      veneer faces.
   B. Products Installed but not Furnished Under this Section
      1. Section 08 71 00 - Door Hardware: Furnishing of finish hardware.
   C. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 1 Specification Sections, apply to this Section.
   D. Related Sections
      1. Section 08 13 00 - Steel Doors and Frames: Provision of steel door frames.
      2. Section 08 80 00 - Glazing: Provision of glass and glazing.
      3. Section 09 90 00 - Painting and Coating: For field painting primed doors.

1.02 REFERENCES
   A. ASTM - American Society for Testing and Materials
      1. E90 - Standard Test Method for Laboratory Measurement of Airborne Sound
         Transmission Loss of Building Partitions and Elements.
      3. E413 - Classification for Rating Sound Insulation.
   B. AWI - American Woodwork Institute
   C. DHI - Door and Hardware Institute
      2. WDHS-3 - Recommended Hardware Locations for Wood Flush Doors.
   D. NFPA - National Fire Protection Association
      1. 80 - Fire Doors and Windows.
   E. WDMA - Window and Door Manufacturers Association
   F. UBCS - Uniform Building Code Standard
      1. 7-2 - Fire Tests of Door Assemblies.
   G. UL - Underwriters Laboratory, Inc.

1.03 SUBMITTALS
   A. Product Data: Submit product data for each type of door, including details of core and edge
      construction, trim for openings and louvers, factory-finishing specifications and veneer
      species, type and characteristics.
B. Shop Drawings: Submit shop drawings indicating location and size of each door referenced to the Architect’s door mark and hardware group, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for factory finishing, cut-outs for glazing and other pertinent data.
1.  For factory-machined doors, indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light and louver openings.
2.  Samples for verification in the form and size indicated below (as indicated on drawings):
   a.  Louvers consisting of blade and frame, 6 inches long, for each material and finish specified.
   b.  Frames for light openings, 6 inches long, for each material, type, and finish required.
C.  Test Reports for Sound Rated Doors: Submit independent laboratory acoustical test report indicating STC rating measured in accordance with ASTM E90 and ASTM E413.
   1.  STC Rating: 42.
D. Specimen Warranty.
E. Samples: Submit two samples of door veneer, 8 x 12 inch in size, illustrating wood grain, stain color and sheen.
F. Manufacturer’s installation instructions. Indicate special installation instructions.
G. Warranty, executed in Owner’s name – Contra Costa Community College District, Los Medanos College.

1.04 QUALITY ASSURANCE
A. Regulatory Requirements
   1.  Fire Rated Wood Doors: Provide wood doors that comply with NFPA 80; are identical in materials and construction to units tested in door and frame assemblies per ASTM E152, and are labeled and listed by UL, Warnock Hersey or another testing and inspection agency acceptable to authorities having jurisdiction.
   2.  Temperature Rise Rating: At stairwell enclosures, provide doors that have a temperature rise rating of 450 degrees Fahrenheit maximum in 30 minutes of fire exposure specified in UBCS 7-2.
B. Quality Standard
   1.  WDMA Quality Standard: I.S.1-A.
C. Sound Rated Doors: Doors with an STC rating shall bear manufacturer’s label designating sound retardant construction.

1.05 DELIVERY, STORAGE AND HANDLING
A. Packing and Shipping: Identify each door with individual opening numbers as designated on shop drawings, using temporary, removable or concealed markings. Use the Architect’s door numbering system.
B. Storage and Protection: Protect doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standard and manufacturer’s instructions.

1.06 PROJECT CONDITIONS
A. Environmental Requirements: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
B. Coordinate the work with door opening construction, door frame and door hardware installation.

1.07 WARRANTY

A. General Warranty: Door manufacturer’s warranty specified in this Article shall not deprive the District of other rights the District may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Door Manufacturer’s Warranty: Submit written agreement on door manufacturer’s standard form signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) more than 1/4-inch in a 42 inch by 84 inch section or that show telegraphing of core construction in face veneers exceeding 0.01-inch in a 3 inch span, or do not conform to tolerance limitations of referenced quality standards.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.

2. Warranty shall be in effect during the following period of time after date of Substantial Completion, Beneficial Occupancy or Notice of Completion, whichever is earlier.


PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Algoma Hardwoods, Inc.; Eggerts Industries, Architectural Door Division; Marshfield Door Systems (formerly Weyerhaeuser Co.), or equal.

2.02 MATERIALS

A. Interior Solid Core Doors for Transparent Finish

1. Faces: Quarter figured as selected by Architect.
2. Grade: Premium with Grade AA faces.
3. Construction: 5 plies.
5. Core: Particleboard core.
7. Assembly of Veneer Leaves on Door Faces: Center balance.
8. Bonding: Stiles and rails bonded to core, then entire unit abrasive planed before veneering.
9. Facing Adhesive: Type II - water-resistant.

B. Interior Fire Rated Solid Core Doors

1. Faces and Grade: Provide faces and grade to match non-fire rated doors in same area of building, unless otherwise indicated.
2. Construction: Manufacturer’s standard core construction as required to provide fire-resistance rating indicated.
3. Blocking: Provide composite blocking designed to maintain fire resistance of door but with improved screw-holding capability of same thickness as core and with minimum dimensions as follows:
   a. 5 inch top rail blocking.
   b. 5 inch bottom rail blocking.
   c. 5 inch by 18 inch lock blocks.
   d. 5 inch midrail blocking.
4. Edge Construction: Provide manufacturer’s standard laminated edge construction for improved screw-holding capability and split resistance as compared to edges composed of a single layer of treated lumber.

5. Pairs: Furnish formed steel edges and astragals for pairs of fire rated doors, unless otherwise indicated.

6. Testing: Tested to ratings indicated on drawings in accordance with International Building Code ("positive pressure"); UL or WH (ITS) labeled without any visible seals when door is open.

7. Facing Adhesive: Type II – water-resistant.

C. Interior Sound Rated Solid Core Doors
   1. Faces and Grade: Provide faces and grade to match non-sound rated doors in same area of building, unless otherwise indicated.
   2. Construction: Manufacturer’s standard core construction as required to provide sound rating indicated.
   3. Where latch jamb gaskets protrude more than 1/2-inch, prepare door for latch hardware with additional backset.
   4. Provide 16 gauge CRS 1-piece welded door frames with integral stops. Size door frame with gaskets to have a minimum 36 inches horizontal clearance and 84 inches vertical clearance, unless otherwise indicated.
   5. Sound Retardant Doors: Minimum STC of 50, calculated in accordance with ASTM E 413, tested in accordance with ASTM E 1408. Equivalent to Type PC construction with core as required to achieve rating specified.
   6. Facing Adhesive: Type II – water-resistant.

D. Metal Louver (as occurs): Size, type, and profile shown and fabricated from galvanized steel, 0.0396-inch thick; hot dip, zinc coated and factory primed for paint finish.

E. Acoustical Door Gaskets: Provide the following at 1-3/4 inch thick, STC 45 sound rated doors for items listed below. Coordinate with hardware group as indicated on Door Schedule Sheet 8.01.
   1. Bulb at Head and Jamb Stop
   2. Head and Jambs
   3. Automatic Door Bottom
   4. Threshold
   5. Astragals

F. Gypsum Plaster: USG, "Structolite", or equal.

G. Hardware: As specified in Section 08 71 00.

H. Glass: As specified in Sections 08 80 00.

I. Glazing Stops: Wood, of same species as door facing, butt(c)ed corners; prepared for countersink style tamper proof screws.

2.03 FABRICATION

A. Fabricate flush wood doors to comply with the following requirements:
   1. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI WDHS-3. Comply with final hardware schedules, door frame shop drawings, DHI A115-W series standards, and hardware templates.
      a. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory machining.

B. Openings: Factory cut and trim openings through doors to comply with applicable requirements of referenced standards for kinds of doors required.
   1. Light Openings: Trim openings with moldings of material and profile indicated.
   2. Louvers: Factory install louvers in prepared openings.

FLUSH WOOD DOORS
08 14 16-4
2.04 FACTORY FINISHING
A. Doors for Transparent Finish: Shop seal faces and edges of doors for transparent finish with stain, other required pretreatments and first coat of finish as specified in Section 09900.

2.05 FINISHES
A. Transparent Finish: As specified in Section 09 90 00. Premium quality, satin sheen.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine installed door frames prior to hanging door:
   1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
   2. Reject doors with defects.
B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Door Hardware: See Section 08 71 00.
B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and referenced quality standard and as indicated.
   1. Install fire rated doors in corresponding fire rated frames according to requirements of NFPA 80.
C. Job-Fit Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire rated doors. Seal cut surfaces after fitting.
   1. Fitting Clearances for Non-Fire Rated Doors: Provide 1/8-inch at jambs and heads; 1/16-inch per leaf at meeting stiles for pairs of doors, and 1/8-inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4-inch clearance from bottom of door to top of threshold.
   2. Fitting Clearances for Fire Rated Doors: Comply with NFPA 80.
   3. Bevel non-fire rated doors 1/8-inch in 2 inches at lock and hinge edges.
   4. Bevel fire rated doors 1/8-inch in 2 inches on lock edge; trim stiles and rails only to extent permitted by labeling agency.
D. Installation of Sound Rated Doors
   1. Install all sound rated door and gasket assemblies in accordance with manufacturer's instructions.
   2. Fill metal door frames at openings with gypsum plaster.
   3. Install all doors, frames, and gasket assemblies plumb and square to provide a continuous seal. Damaged or discontinuous gaskets shall be replaced at no cost to the District.
   4. Coordinate all gaskets at sound rated doors with other hardware to provide a continuous perimeter seal. Provide shim to mount automatic closers as required to clear gaskets.
   5. Install the threshold's horizontal surface 1/4-inch above the finish surface on the swing-side of the doors.
   6. Apply and adjust all gaskets to form an airtight seal with latching and closure forces in compliance with accessible code requirements and the American Disabilities Act.
3.03 INSTALLATION TOLERANCES
   A. Conform to specified quality standard for fit and clearance tolerances.
   B. Conform to specified quality standard for maximum diagonal distortion.
   C. Maximum Vertical Distortion (Bow): 1/8 inch measured with straight edge or taut string, top to bottom, over an imaginary 36 by 84 inches surface area.
   D. Maximum Width Distortion (Cup): 1/8 inch measured with straight edge or taut string, edge to edge, over an imaginary 36 by 84 inches surface area.

3.04 ADJUSTING AND PROTECTION
   A. Operation: Rehang or replace doors that do not swing or operate freely.
   B. Finished Doors: Refinish or replace doors damaged during installation.
   C. Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at the time of Substantial Completion.

END OF SECTION
SECTION 08 31 13
ACCESS DOORS AND PANELS

PART 1- GENERAL

1.01 SECTION INCLUDES
   A. Access door and frame units, fire-rated, in wall locations.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 33 00 – Submittal Procedures.
   B. Product Data: Provide sizes, types, finishes, hardware, schedule locations, and details of adjoining work.
   C. Shop Drawings: Indicate exact position of all access door units.
   D. Manufacturer’s Installation Instructions: Indicate installation requirements.

1.05 REGULATORY REQUIREMENTS
   A. Conform to applicable code for fire rated access doors.
      1. Provide access doors of fire rating equivalent to the fire rated assembly in which they are to be installed.
   B. Provide products listed and labeled by UL or ITS (Warnock Hersey) as suitable for the purpose specified and indicated.

1.06 PROJECT CONDITIONS
   A. Coordinate the work with other work requiring access doors.
PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Access Doors:

2. Acceptable manufacturers:
3. Substitutions: See Section 01 60 00 – Product Requirements.

2.02 ACCESS DOOR AND PANELS
A. All Units: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.
B. Units in Fire Rated Assemblies: Fire rating equivalent to the fire rated assembly in which they are to be installed.

2.03 ACCESS DOORS UNITS – WALLS AND CEILINGS
A. Door and Frame Units: Formed steel.
   1. Frames and flanges: 0.058 inch steel.
   2. Door panels: 0.070 inch single thickness steel sheet.
   3. Size: Size as called out on drawings or if not called out, then size to allow access to equipment in wall/ceiling cavities but not less than 12 x 12 inches in walls and 20 x 20 inch in ceilings.
   4. Hardware:
      a. Hinge, Fire-Rated Units: 175 degree steel hinges with non-removable pin.
      b. Hinge: 175 degree stainless steel piano hinge with removable pin.
      c. Lock: Cylinder lock with latch, two keys for each unit.
   5. Prime coat with alkyd primer typical.
   6. Finish: No. 4 stainless steel finish in toilet rooms and at exterior installations.
B. Non-Fire Rated Door and frame Units in Walls:
   1. In Gypsum Board on Steel Studs:
      a. Model RDWP5 manufactured by Karp Associates
   2. In Metal Soffits on steel frames.
C. Fire Rated Door and Frame Units in Walls:
   1. In Gypsum board on Steel Studs:
      a. 1 hour fire rating.
      b. Model KRP-150 FR manufactured by Karp Associates when less than 24 inches in either direction.
c. Custom fire-rated unit similar to Model RDW manufactured by Karp Associates when greater than 15 inches in either direction.

2.04 FABRICATION
   A. Weld, fill, and grind joints to ensure flush and square unit.

PART 3 – EXECUTION

3.01 INSTALLATION
   A. Install units in accordance with manufacturer's instructions.
   B. Install frames plumb and level in openings. Secure rigidly in place.
   C. Position units to provide convenient access to the concealed work requiring access.

END OF SECTION
SECTION 08 41 13

ALUMINUM-FRAMED STOREFRONTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.
B. Aluminum doors and frames.
C. Perimeter sealant.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Perimeter sealant and back-up materials.
B. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
C. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2004.
B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; American Architectural Manufacturers Association; 2003 (part of AAMA 501).
M. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights,
Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000.


1.04 PERFORMANCE REQUIREMENTS

A. Design and size components to withstand the following load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   1. Design Wind Loads: Comply with requirements of California Building code.
   2. Member Deflection:
      Maximum deflection for the mullions to be ¼".
      Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

B. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.

C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at a reference differential pressure across assembly of 1.57 psf as measured in accordance with ASTM E 283.

D. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 2.86 lb/sq ft.

E. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

F. Expansion/contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, dimensional limitations.

E. Samples: Submit two samples 6 X 8 inches in size illustrating finished aluminum surface, glass, infill panels, glazing materials.

F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

G. Report of field testing for water leakage.

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

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision
of a Professional Structural Engineer experienced in design of this Work and licensed at California.

B. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 01 77 10 - Contract Closeout, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide twenty year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

   1. Storefront Framing: Kawneer Tri-Fab 451 T.
   2. Entrance Doors: Kawneer 500 Heavy Wall Door
      a. Vertical stile and top rail: 5-inches
      b. Bottom Rail: min. 10-inches

B. Substitutions: See section 01 60 00 – Material and Equipment.

2.02 COMPONENTS

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   2. Color: To match campus standard colors: Dark Bronze and clear anodized, in locations as noted on Drawings.

2.03 MATERIALS


C. Structural Steel Sections: ASTM A 36/A 36M; galvanized in accordance with requirements of ASTM A 123/A 123M.

D. Exposed Flashings: 0.032 inch thick aluminum sheet; finish to match framing members.
E. Concealed Flashings: 0.018 inch thick galvanized steel.
F. Perimeter Sealant: Type SJ-4 specified in Section 07900.
G. Glass: As specified in Section 08 80 00.
H. Glazing Accessories: As specified in Section 08 80 00.
I. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.04 FINISHES
A. High Performance Organic Finish: AAMA 2604; multiple coats, thermally cured fluoropolymer system; color as scheduled.

2.05 HARDWARE
A. Door Hardware: As specified in Section 08 71 00.
B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
C. Sill Sweep Strips: provide on all doors. EPDM blade gasket sweep strip, resilient seal type, retracting, of neoprene, in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners.
D. Weatherstripping:
   1. Meeting stiles on pairs of doors shall be equipped with an adjustable astragal utilizing wool pile with polymeric fin.
   2. The door weathering on a single acting offset pivot or butt hung door and frame (single or pairs) shall be Kawneer Sealair® weathering. This is comprised of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.
E. Threshold: as detailed on Drawings.

2.06 FABRICATION
A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
C. Prepare components to receive anchor devices. Fabricate anchors.
D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
E. Arrange fasteners and attachments to conceal from view.
F. Reinforce framing members for imposed loads.
G. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.  
   1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Verify dimensions, tolerances, and method of attachment with other work.
B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.
3.02 INSTALLATION
   A. Install wall system in accordance with manufacturer’s instructions.
   B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
   C. Provide alignment attachments and shims to permanently fasten system to building structure.
   D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
   E. Provide thermal isolation where components penetrate or disrupt building insulation.
   F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
   G. Coordinate attachment and seal of perimeter air and vapor barrier materials.
   H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
   I. Set thresholds in bed of mastic and secure.
   J. Install glass in accordance with Section 08 80 00, using exterior wet/dry glazing method.
   K. Install perimeter sealant in accordance with Section 07 92 00.
   L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES
   A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
   B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL
   A. See Section 01 43 00 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.
   B. Test installed storefront for water leakage in accordance with AAMA 501.2.

3.05 ADJUSTING
   A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING
   A. Remove protective material from pre-finished aluminum surfaces.
   B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
   C. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION
   A. Protect installed products from damage during subsequent construction.

END OF SECTION
SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnish door hardware in accordance with hardware group as indicated.
   2. Furnish templates and hardware list of hardware as required.
   3. Furnish cylinder for entrance doors, coiling doors, electrical panels and fire alarm panels.

B. General provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

C. Related Sections:
   1. Section 08 11 00 – Steel Doors and Frames: Installation of finish hardware accordance with standards of this Section.
   2. Section 08 41 00 – Glazed Aluminum Curtainwalls: Installation of weather seals for entrances in accordance with standards of this Section.

1.02 REFERENCES

A. ADA - Americans with Disabilities Act


C. DHI - Door and Hardware Institute.
   1. RL – Recommended Locations for Builders Hardware for Standard Steel Doors and Frames.

   1. NFPA 80 - Fire Doors and Windows

E. NWWDA – National Wood Window and Door Association
   1. I.S.1.7 – Hardware Location for Wood Flush Doors.

F. UL - Underwriters Laboratories, Inc.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for each item of door hardware installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
   1. Final hardware schedule, incorporating the Architect’s door numbering system coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

B. Samples: Submit samples of each type of exposed hardware unit in finish indicated and tagged with full description of coordination with schedule. Submit samples prior to submission of final hardware schedule.
1. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated in the Work, within limitation of keying coordination requirements.

C. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Fire Rated Openings: Provide door hardware for fire rated openings that complies with NFPA 890 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL or Intertek Testing Services.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping
   1. Individually package each unit of finish hardware, complete with proper fastenings and appurtenances, clearly marked on the outside to indicate contents and specific location on the Work.
   2. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in the same container.
      a. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

B. Acceptance at Site: Deliver individually packaged door hardware items promptly to place of installation (Sop or Project site).

C. Storage and protection: Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware loses both before and after installation.

1.06 MAINTENANCE

A. Maintenance Tools and Instructions: With delivery of keys, furnish a complete set of specialized tools and maintenance instructions as needed for the District’s continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.01 GENERAL

A. Fasteners
   1. Furnish necessary screws, bolts, and other fasteners of suitable size and type to anchor the hardware in position for long life under hard use.
2. Where necessary, furnish fasteners with toggle bolts, expansion shields, sex bolts, and other anchors approved by the architect, according to the material to which the hardware is to be applied and according to the recommendations of the hardware manufacturer.
3. Provide fasteners which harmonize with the hardware as to finish and material.

B. Where butts are required to swing 180 degrees, furnish butts of sufficient throw to clear the trim.

C. Furnish silencers for door frames at the rate of 3 for each single door and 2 for each door or pair of doors; except weather-stripped doors and doors with light seals, smoke seals or sound seals.

2.02 KEYING

A. Factory key, masterkey, and grand-masterkey locks and cylinders as directed by the District. Corbin Russwin N-23 Keyway is Campus Standard.

B. Furnish 3 keys for each lock, 12 masterkeys for each set, and 3 grand-masterkeys.

C. Construction Keying
1. Furnish a construction masterkey system with 5 keys for locks and cylinders. No more than 5 for any group. The rest in blanks.
2. Use only the construction keys during construction.
3. Upon Substantial Completion of the work, as that Date is established by the Architect, Campus Facilities personnel will void constriction key system.

D. Identification and Delivery
1. Factory stamp permanent keys, “DO NOT DUPLICATE”.
2. Send direct to the District by direct delivery the IC cores and keys specified. Order hardware-less cores for faster delivery.

2.03 HINGES

A. General
1. provide hinges having minimum of 5 knuckles.
2. provide ball-bearing hinges having concealed bearings and interior self-lubricating bushings.
3. Provide ball bearing hinges on doors with closers.
4. Provide fire-resistance doors with steel hinges.
5. Provide interior doors with non-rising hinges.
7. Provide template hinges conforming to ANSI A156.7.
8. Size: In accordance with the following table unless specifically noted otherwise:
   a. Butt Height
      1) Doors 1-3/8 Inches Thick: 3-1/2 inches.
      2) Doors 1-3/4 Inches Thick and Up to 41 Inches wide: 4-1/2 inches.
      3) Doors 1-3/4 Inches and from 41 inches to 48 inches wide: 4-1/2 inches extra heavy.
      4) Doors 2 Inches Thick of Over 48 Inches Wide: 5 inches extra heavy.
   b. But Widths: Sufficient to clear trim projection when door swings 180 degrees.
   c. Number Per Door Leaf Unless Otherwise Noted:
      1) Door to 60 inches high: 2 hinges.
      2) Door to 90 inches high: 3 hinges.
3) door to 120 inches high: 4 hinges.

B. Material
2. Interior: Steel, ball-bearing.
3. Manufacturer: Ives (IVE), Hager Hinge, Stanley or McKinney.

2.04 LOCKSETS, LATCHSETS AND HANDLESETS

A. General
1. Cylinders
   a. Minimum 6 pin interchangeable core cylinders with steel cylindrical cases, and all interior parts shall be non-ferrous. Do not supply plastic, die-cast or aluminum mechanisms.
   b. Provide in keyway as specified. Corbin Russwin N-23 keyway is Campus Standard.
   c. Furnish with plugs of extruded brass bar material full round without flattened areas.
2. Locksets: Provide lockset types specified from the same manufacturer and capable of receiving cylinders complying with requirements specified in "Cylinders" paragraph above.
3. Heavy Duty Cylindrical Locksets
   a. Product: Corbin-Russwin (C-R), "CL3100 Series" of "NZD" design.
4. Backset: 3-3/4 inches, unless otherwise noted.
5. Strikes
   a. Type: Standard type with extended lips where required to protect trim from marring by latch bolt. Verify cutout types provided in metal frames. Locks shall have stainless steel, 3/8-inch throw.
   b. Material: Same as lock trim.
6. Quantity: Provide 1 lockset assembly for each door opening in accordance with the Schedule, unless other noted. Install lockset on active leaf or pair of doors. Pairs of doors scheduled to receive roller latches shall have one for each leaf.
7. Provide matching door handle on left leaf where needed.

2.05 CLOSERS

A. General
1. Provide closers having maximum effort to operate in accordance with CBC Sections 11B-404.2.8.1& 1008.1 and ADA as follows:
   a. Exterior Hinges Doors: 5 pounds.
   b. Interior Hinges Doors: 5 pounds.
   c. Fire Doors: The Authority having jurisdiction may increase the maximum effort to operate fire doors to achieve positive latching, but not to exceed 15 pounds.
2. Adjust closers in accordance with manufacturer's directions for size of door.
3. Provide closers having:
   a. Full rack and pinion with steel spring and non-gumming, non-freezing hydraulic fluid.
   b. Provide complete set of separate controls for regulating sweep speed, latch speed, and backcheck. Sizes as recommended by reviewed manufacturer.
   c. Per 11B-404.2.8.1, door shall take at least 5 seconds to move from an open position of 90 degrees to a position of 12 degrees from the latch jamb.

B. Door Surface Applied Modern Closers:
1. Provide closers with molded plastic covers capable of receiving finishes as specified in Article titled "Finishes" in this Section.
2. Provide drop plates at doors having narrow frames.
3. Product: LCN (LCN), or Norton.

C. Quantity: Provide each leaf in pairs of doors schedule to receive closers.

D. Overhead and Floor Concealed Closers:
1. Provide concealed closes with fully-adjustable spring power, non-gumming, non-freezing hydraulic fluid and delayed action closing, where specified.
2. Furnish pivots sets from same manufacturer as concealed closers.
3. Provide spindle height to suit installation requirements.
4. Product: Rixson (RIX), Division of Assa-Abloy.

2.06 EXIT DEVICES

A. Exit devices: Von Duprin (VON) as scheduled with push-through pad design, no exposed touch bar fasteners, no exposed cavities when operated.
1. Provide certificate by independent testing laboratory that device has completed over 1,000,000 cycles and can still meet ANSI/BHMA A156.3 - 2007 standards.
2. Compression spring engineering.
3. Non-handed basic device design with center case interchangeable with all functions.
4. All devices shall have quiet return fluid dampeners.
5. All latchbolts shall be deadlocking with ¾" throw and have a self-lubricating coating to reduce friction and wear.
6. Device push bar must release when a force of 32 pounds, or less, of pressure is applied when a force of 250 pounds is applied to the door.
7. Device shall bear UL label for fire and or panic as may be required.
8. All surface strikes shall be roller type and utilize a plate underneath to prevent movement.
9. Panic Hardware shall comply with CBC 1008.1.9.2 and 11B.404.2.7 and shall be mounted between 34" and 44" above the finished floor surface. The unlatching force shall not exceed 15 lbs. applied in the direction of travel. Panic hardware shall comply with CBC Section 1008.1.10.1

2.07 STOPS AND HOLDERS

A. General
1. Unless otherwise noted in Hardware Sets, provide wall type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
2. Do not install floor stops more than four (4) inches from the face of the wall or partition (11B-307).
3. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.
4. Manufacturer: Ives (IVE), Trimco, or Builders Brass.

2.08 AUTO BOLTS

A. General
1. Automatic Flush Bolts shall be of the low operating force design. Utilize the top bolt only model for interior doors where applicable and as permitted by testing procedures.
2. Manual flush bolts only permitted on storage or mechanical openings as scheduled.
3. Provide dust proof strikes at openings using bottom bolts.
4. Manufacturer: Ives (IVE), Trimco or Builders Brass.
2.09 DOOR PROTECTION PLATES

A. General
1. Kick Plates
   a. Width and Anchorage: Provide plates 2 inches narrower than single doors or 1 inch narrower than pair of doors. Ensure anchorage to bottom rail
   b. Height: Minimum 10 inches.
   c. Thickness: Stainless steel, 0.050-inches thick, with beveled edges 3 sides.
   d. Quantity: Provide kick plates on push side of doors unless scheduled differently.
2. Manufacturer: Ives (IVE), Trimco or Builders Brass.

2.10 THRESHOLDS

A. General
1. Provide thresholds that comply with the disability requirements of the ADA.
2. Set thresholds solidly to floor.
3. Provide thresholds notched at frame stops and entire with of frame.
4. Material: Extruded aluminum, unless otherwise noted.
5. Manufacturer: National Guard Products (NGP), or Pemko.
6. Thresholds shall comply with CBC Section 11B-404.2.5.
7. See threshold details for model numbers.

2.11 WEATHER-STRIPPING / SEAL

A. General
1. Fire and Smoke
   a. Material: Self-adhesive silicon seal, rated for fire and smoke in accordance with ASTM E283, sound rated in accordance with ASTM E90.
2. Manufacturer: National Guard Products (NGP), or Pemko.
   a. Extent: Seal sets shall consist of gasketing that is continuous at head and jambs.
3. Sound and Thermal Seals
   a. Material: Aluminum unless otherwise noted, with adjustable extruded EPDM closed cell sponge neoprene and fire labeled in accordance with ASTM E152, UL 10C and CBC.
   b. Extent: Sound seal sets shall consist of Gasketing that is continuous at head and jambs.

2.12 MISCELLANEOUS

A. Miscellaneous items include, dust proof strikes, coordinators, and exit alarms and alarm contact switches, power supplies.
   1. Manufacturer: See Schedule.

2.13 KEY CONTROL SYSTEM

A. General
1. Provide system including envelopes, labels, tags with self-locking key clips, receipt forms, three-way visible card index, temporary markers, permanent markers, and standard metal cabinet, as recommended by system manufacturer, with capacity for 150 percent of the number of locks require for the Project.
2. Provide complete cross index system set up key control manufacturer and place keys on markers and hooks in the cabinet as determined by the final key schedule.
3. Provide hinged-panel type cabinet for wall mounting.
4. Provide "simplex" type push button lock on cabinet. Furnish Telkee (TEL) "AWC450S-SMTC" or equal.

2.14 SILENCERS

A. General
1. Material: Pneumatic rubber, installed in metal frame stops.
2. Quantity: Furnish 3 for single doors and 2 for each door for pairs of doors.
3. Manufacturer: Ives (IVE), Trimco or equal.

2.15 FINISH

A. Generally to be satin stainless US32D (BHMA 630) unless otherwise noted.
B. Door closers shall be powder-coated to match other hardware, unless otherwise noted.
C. Aluminum items to be finished anodized aluminum US28 (628), except thresholds which can be furnished as standard mill finish.

2.16 KEY BOX

A. Contact jurisdictional fire department and obtain order forms necessary to order Knox Company, 3200 Series Knox Box, recessed mount with hinged door.
1. Box and lockare to be UL listed.
2. Color: Aluminum.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine doors and door frames for damage or defects and examine hardware for compatibility with receiving conditions and suitability to intended use.
B. Verify that required wall backing has been installed.
C. Do not install hardware until unsuitable conditions have been corrected or inadequate or defective items have been replaced.

3.02 PREPARATION

A. Coordinate with work requiring hardware or work to which harder attaches.
B. Provide necessary copies of schedules or templates in ample time to avoid fabrication and construction delays.
C. Provide key control system installer with 1 reviewed copy of hardware schedule and keying instructions.

3.03 INSTALLATION
A. Mount hardware units at heights indicated in DHI RL and NWWDA I.S.1.7, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by the Architect. Mount floor stops maximum 4" from wall.

B. Install each hardware item in compliance with the manufacturer’s instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in Section 09900. Do not install surface mounted items until finishes have been completed on the substrates involved.

C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standard.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Section 07900.

F. Weather-striping and Seals:
1. Comply with manufacturer’s instructions and recommendations to the extent installation requirements are not otherwise indicated.
2. Provide door shoe or other bottom door seal / weatherstripping at all exterior and stairwell doors.

3.04 ADJUSTING, CLEANING AND DEMONSTRATING

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made. Doors must be adjusted to ADA requirements at punch list completion.

B. Clean adjacent surface soiled by hardware installation.

C. Instruct the District’s Personnel in proper adjustment and maintenance of hardware finishes.

Manufacturers Abbreviations (Mfr.)

*C-R = Corbin-Russwin  Locksets, Latchsets & Cylinders
GLY = Glynn-Johnson Corporation  Overhead Door Stops
IVE = Ives  Hinges, Bolts, Coordinators, Dust Proof
Strike, Kick Plates, Door Stops & Silencers
*LCN = LCN  Door Closers & Auto Operators
*VON = Von Duprin  Exit Devices, Electric Strikes
ZER = Zero International  Thresholds, Gasketing & Weather-stripping
* Items indicated with asterisk are Campus Standard – NO SUBSTITUTIONS.

SPEXTRA: 234930

GROUP NO. 01

DOOR HARDWARE
08 71 00-8
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**READER, POWER SUPPLY AND WIRING BY ACCESS CONTROL VENDOR**

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**DOOR HARDWARE**

08 71 00-9
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READER, POWER SUPPLY AND WIRING BY ACCESS CONTROL VENDOR

DOOR HARDWARE
08 71 00-11
END OF SECTION
SECTION 08 71 30

LOW ENERGY DOOR OPERATOR

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Provision of entrance door operator and associated equipment.

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

C. Related Sections
   1. Section 01330 – Submittal Procedures: For submittal procedures.
   4. Section 087100 – Finish Hardware – Provision of door hardware.

1.02 REFERENCES


   1. 80 – Standard for Fire Doors and Other Opening Protectives.

B. UL – Underwriters Laboratories Inc.

1.03 SYSTEM DESCRIPTION

A. Design Requirements: Provide automatic entrance door system that complies with performance requirements indicated.
   1. Wind loads: Provide automatic entrance door assembly capable of withstanding wind pressures of 20 psf inward and 20 psf outward acting normal to the plane of the wall.
   2. Thermal Movement: Design the automatic entrance door system to provide for expansion and the contraction of the component materials. Door shall function normally over the specified temperature range.
      a. The system shall be capable of withstanding a metal surface temperature range of 180 degrees Fahrenheit without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass or other detrimental effects.
   3. Operator: Provide operator that will open and closer the door and maintain it in fully closed position when subjected to a 20 mph wind velocity or the equivalent inward differential pressure.

1.02 SUBMITTALS

A. Submit under provisions of Section 01330 Submittal Procedures.
B. **Product Data:** Submit shop data for automatic entrance, including the manufacturer's standard details and fabrication methods and the following:
   1. Data on operators, hardware and accessories.
   2. Roughing-in diagrams.
   3. Parts lists.
   4. Data on finishes and recommendations for maintenance and cleaning of exterior surfaces.

C. **Shop Drawings:** Submit shop drawings for automatic entrance, including:
   1. Layout and installation details, including relationship to adjacent work.
   2. Elevation at ¼-inch = 1 foot scale.
   3. Detail sections of typical composite members.
   4. Anchors and reinforcement.
   5. Hardware mounting heights.

D. **Submit wiring diagrams detailing wiring for power operator, signal and control systems differentiating clearly between manufacturer installed wiring and field installed wiring.**

E. **Quality Control Submittals:** Provide certified test reports from a qualified independent testing laboratory showing that automatic entrance door systems have been tested in accordance with specified test procedures and comply with performance characteristics indicated.

F. **Contract Closeout Submittals:** Submit manufacturer’s maintenance and service data for door operators and control system including the name, address and telephone number of the nearest authorized service representative.

1.03 **QUALITY ASSURANCE**

A. **Installer Qualifications:** Experienced installer who is an authorized representative of the manufacturer for both the installation and maintenance of the type of units required for this Project.
   1. **Maintenance Proximity:** The installer shall maintain offices and repair of service facilities not more than 2 hours normal travel time from the Project site.

B. **Manufacturer Qualifications:** Provide automatic entrance doors produced by a firm experienced in manufacturing systems that are similar to those indicated for this Project and that have a record of successful in-service performance.

C. **UL Standard:** Provide powered door operators that comply with UL 325.

D. **Emergency Exit Door:** Automatic entrance door serving as a required means of egress shall comply with requirements of authorities having jurisdiction. Provide manufacturer’s certification that door complies with these requirements.

1.06 **WARRANTY**

A. **Warranty:** Submit a written warranty, executed by the manufacturer, authorizing to repair or replace components of the automatic entrance door systems that fail in materials or workmanship within the specified warrant period. Failures include, but are not necessarily limited to:
   1. Structural failures including excessive deflection, excessive leakage or air infiltration.
   2. Faulty operation of operators and hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

B. Warranty Period: 3 years after the date of Substantial Completion.
C. The warranty shall not deprive the District of other rights of remedies that the District may have under other provisions of the Contract Documents and is in addition to, and runs concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturer: Provide products made by LCN, Horton or equal.

2.02 OPERATORS

A. Operation: Push button, push plate, switch-activated, manual or field-programmable manual/electric power assisted Push-N-Go opening; comply with ANSI A156.19 and UL 325.

1. Close and center door open against stop after each cycle, and hold against drafts, winds and stack pressure.
3. Factory-set door hold-open voltage.
5. Fall safe: In event of power failure, make door operate manually with controlled spring close as though equipped with a #3 manual door closer, without damage to operator components.
6. Provide adjustment by microprocessor control for:
   a. Opening speed.
   b. Back check.
   c. Hold open, from 5 to 30 seconds.
   d. Closing speed.
   e. Opening force.
   f. Acceleration during opening and recycling, for soft start.
   g. Door will safely stop and reverse if an object is encountered in the opening or closing cycle.

B. Equipment: Completely electro-mechanical; comply with ANSI A156.19 and UL 325.

1. Control box and motor/gear box: Contained in aluminum housing; precision-machined gears and bearing seats and all-weather lubricant, mounted on vibration isolators.
   a. Design for overhead concealed application.
   b. Design for exterior application.
2. Gears: Manufactured by operator manufacturer specifically for operators.
3. Motor: DC permanent magnet motor with shielded ball bearings. Stop motor when door stops or is fully open and when break-away is operated.
4. Door operating arm: Forged steel, attached at natural pivot point of door; do not use slide block in top of door.
   a. Exposed arms: Factory polished and finished to match operator enclosure.
5. "On-Off-Hold Open" switch: Three-position toggle or rocker type.
6. Control circuits for actuators and safeties: Low voltage, NEC Class II.
7. Service conditions: Satisfactory operation between minus 30 degrees F (minus 34 degrees C) and 160 degrees F (71 degrees C).
8. Power supply required: 115 VAC.
10. Battery Back-up complying with CBC.

B. Enclosure: Overhead header concealing all operating parts except arms and manual control switches.
1. Surface Mounting: Surface-Applied Mounting: On surface of door frame/wall, maximum of 1/8 inch (3 mm) above top of door.
2. Provide access door on bottom of enclosure for access to controls and removable components without removal of door or operator.
2. No exposed fasteners.

2.03 ACTUATORS

A. Provide actuators with wireless remote switch.
1. Material: Stainless Steel.

B. Provide receivers for wireless operation.
C. Card Reader: By Others.

2.04 MARKINGS

A. Decals: Visible from either side, instructing the user as to the operation and function of the door.

2.05 LIST OF MATERIAL OR EQUAL

Manufacturers Abbreviations (Mfr.)

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SPEXTRA: 234930

GROUP NO. 01

| 1 | EA | SURF. AUTO OPERATOR         | 9553 REG2 MS | ANDKB | LCN |
| 2 | EA | RECEIVER                   | 8310-865    | BLU   | LCN |
| 2 | EA | ACTUATOR                   | INGRESS' R I36-5 (WIRELESS) | 630   | WIK |
| 1 | EA | POWER BACK UP              | SUA5000RMT5U |       | APC |

READER, POWER SUPPLY AND WIRING BY ACCESS CONTROL VENDOR
SEE SECTION 087100 FOR ALL OTHER HARDWARE

LOW ENERGRY DOOR OPERATOR
08 71 30-4
PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that door openings and doors are properly installed and ready for installation of door operators.

B. Verify that electrical service is available, properly located, and of proper type.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions; comply with ANSI A156.19.

B. Verify that electrical connections are made correctly.
3.03 ADJUST AND CLEAN

A. Adjust door operators for proper operation, without binding or scraping and without excessive noise.

END OF SECTION
SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glazing
B. Glazing compounds and accessories.
C. Privacy Window Film.

1.02 REFERENCES

K. GANA (SM) - FGMA Sealant Manual; Glass Association of North America; 1990.

1.03 PERFORMANCE REQUIREMENTS

A. Select type and thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with California Building code.
   1. Use the procedure specified in ASTM E 1300 to determine glass type and thickness.
   2. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
   3. Thicknesses listed are minimum.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01 33 00 - Submittals.
B. Product Data: Submit manufacturer’s product data for each glass product and glazing material required.
C. Samples for verification purposes:
   1. (2) 12-inch-square samples of each type of glass indicated except for clear monolithic glass products
   2. (2) 12-inch-long samples of each color required (except black) for each type of sealant or
gasket exposed to view. Install sealant or gasket sample between two strips of material representative in color of the adjoining framing system.

3. (2) 12-inch square samples of privacy window film indicated.

D. Compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.

E. Compatibility test report from manufacturer of insulating glass edge sealant indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.

F. Product test reports for each type of glazing sealant and gasket indicated, evidencing compliance with requirements specified.

G. Maintenance Data: Submit manufacturer's maintenance data for glass and other glazing materials.

H. Installation Instructions: Provide manufacturer's instructions for installation of privacy window film.

1.05 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.


B. Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials.

C. Requirements of Regulatory Agencies:

1. California Building Code (CBC), Title 24, Part 2, Chapter 24. Comply with wind design requirements of Title 24, Part 2, Chapter 16A, Division II.


D. Grading and Labeling: Grade and label each light stating quality and grade of glass and manufacturer's name and brand designation. Leave labels intact until removal is directed by Architect.

E. Glazier Qualifications: Engage an experienced glazier who has completed glazing similar in material, design, and extent to that indicated for Project with a record of successful in-service performance.

F. Single-Source Responsibility for Glass: Obtain glass from one source for each product indicated below:

1. Primary glass of each (ASTM C 1036) type and class indicated.

2. Heat-treated glass of each (ASTM C 1048) condition indicated.

G. Single-Source Responsibility for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.

H. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section, "Project Meetings".

1.06 DELIVERY, STORAGE AND PRODUCT HANDLING

A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent
damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.07 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.08 WARRANTY

A. General: Warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 PRIMARY FLOAT GLASS PRODUCTS

A. Clear Float Glass: ASTM C 1036, Type 1 (transparent glass, flat), Class 1 (clear), quality q3 (glazing select), 1/4 inch thick.

2.02 HEAT-TREATED FLOAT GLASS PRODUCTS

A. Fabrication Process: By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturer's option, except provide horizontal process where indicated as tongless or free of tong marks.

B. Uncoated, Clear, Heat-Treated Float Glass: ASTM C 1048, Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), 1/4 inch thick, kind as indicated below.
   1. FT (fully tempered) where indicated and per code.

2.03 GLAZING SEALANTS

A. General: Provide products complying with the following requirements:
   1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturer's recommendations for selecting glazing sealants and tapes that are suitable for applications indicated and conditions existing at time of installation.
   3. Colors: Provide color of exposed joint sealants to comply with the following:
      a. Match colors indicated by reference to manufacturer's standard designations.
      b. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

B. Sealant: 1-part silicone rubber glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Uses NT, G and A. Provide acid-curing type recommended by manufacturer where only nonporous bond surfaces are contacted; provide nonacid curing type recommended by manufacturer where one or more porous bond surfaces are contacted.

2.04 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
B. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85 plus or minus 5 with proven compatibility with sealants used.

C. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.05 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glass openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

B. Clean cut or flat grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.

2.06 PRIVACY WINDOW FILM

A. Provide privacy window film at interior glazing surfaces of existing windows within project remodel area per dwgs.

B. Acceptable Manufacturers: Provide Decorative Films LLC, "Solyx Blackout Film", color: SXWF-BO Black Film, or equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine glass framing, with glazier present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
   2. Presence and functioning of weep system.
   3. Minimum required face or edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean the glazing channel, or other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used.

3.03 GLAZING, GENERAL

A. Watertight and airtight installation of each piece of glass is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating sash and doors) without failure of any kind including loss or breakage of glass, failure of sealants or gaskets to remain watertight and air-tight, deterioration of glazing materials and other defects in the work.

B. Protect glass from edge damage during handling and installation as follows:
   1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by...
manufacturer's label.

2. Remove damaged glass from Project site and legally dispose of off-site. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.

C. Glazing channel dimensions as shown are intended to provide for necessary bite on glass, minimum edge clearance, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.

D. Comply with combined recommendations and technical reports by manufacturers of glass and glazing products as used in each glazing channel, and with recommendations of GANA’s "Glazing Manual," except where more stringent requirements are indicated.

E. Apply primer or sealer to joint surfaces wherever recommended by sealant manufacturer.

F. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

H. Provide spacers for glass sizes larger than 50 united inches (length plus height) as follows:
   1. Locate spacers inside, outside, and directly opposite each other. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements.
   2. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

I. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.

J. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

K. Provide safety glass in all hazardous locations as required by code, including the following:
   1. Provide safety glass for all glazed panels adjacent to a door, within the same wall plane as the door whose nearest vertical edge is within 12 inches of the door in a closed position and whose bottom edge is less than 60 inches above the floor or walking surface.
   2. Provide safety glass for glazed panels in excess of 9 square feet of area, where the lowest edge is less than 18 inches above the finished floor level or walking surface within 36 inches of such glazing.

L. Cut and install colored (tinted) and heat absorbing glass as recommended in "Technical Services Report No. 130" by PPG Industries.

M. Install insulating glass units to comply with recommendations by Sealed Insulating Glass Manufacturers Association, except as otherwise specifically indicated or recommended by glass and sealant manufacturers.

3.04 GLAZING

A. Cutting and Fitting Glass: Accurately cut and fit glass to opening size. Provide clearance for expansion. Cut and set glass to keep wave lines horizontal. Ensure sharp, clean cut glass edges.

B. Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealants to glass and channel surfaces.

C. Tool exposed surfaces of glazing liquids and compounds to provide a substantial "wash" away
from the glass. Install pressurized tapes and gaskets to protrude slightly out of the channel, so as to eliminate dirt and moisture pockets.

D. Clean and trim excess glazing materials from the glass and stops or frames promptly after installation, and eliminate stains and discolorations.

E. Do not attempt to cut, seam, nip or abrade glass which is tempered, heat strengthened, or coated.

3.05 PRIVACY WINDOW FILM INSTALLATION

A. Preparation: Clean the interior glazing surface to which the film is to be applied, removing all traces of dirt, grime, grease, etc.

B. Cutting: Carefully measure the height and width of the glass surface. Oversize the film up to 3/4" extra material on each side of the film and cut the film to this size. Lay decorative film on a clean flat surface with the release liner up.

C. Wetting of Film: Remove the release liner and spray the exposed adhesive surface thoroughly with the wetting solution (8 drops of very mild detergent into 32 oz. spray bottle). Apply wetting solution to glass surface, to allow proper positioning the film.

D. Film Placement: Place the wetted film onto the clean glass surface. Wet the outside face of the film. Moving from the center out towards the edges, use plastic card squeegee to remove any air bubbles and wetting solution. Double check that the film is flat and smooth with no remaining air bubbles and water.

E. Finishing: Trim the excess film from the edges of the surface. Cut in one continuous movement, using the ruler and razor knife. Cleaning glass surface to remove excess wetting solution around the edges.

F. Drying: The film may take a few days to dry in order for it to completely adhere to the glass surface.

G. Precautions: The glazing surface to which the film will be applied should be very clean, free of dirt, dust particles and silicone. Make sure there are no dry spots on the film prior to placing it onto the glass.

H. Seaming Films: For windows that are wider than the available width of window films, industry standards allow for seaming. Standard installation for seaming is a butt-join type seam. The films are overlapped and cut through with a sharp blade using a straight edge. The excess films are removed.

I. Maintenance: Normal cleaning with a mild window cleaner. It is not recommended that anything abrasive be used.

3.06 CURE, PROTECTION AND CLEANING

A. Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

B. Protect exterior glass from breakage immediately upon installation, by attachment of crossed streamers to framing held away from glass. Do not apply markers of any type to surfaces of glass. Remove nonpermanent labels and clean surfaces.

C. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during the construction period, including natural causes, accidents and vandalism.

D. Protect glass from contact with contaminating substances resulting from construction operations including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass
manufacturer.

E. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkali deposits, or stains, and remove as recommended by glass manufacturer.

END OF SECTION
SECTION 09 23 00

GYPSUM BOARD

PART 1  GENERAL

1.01  SECTION INCLUDES

A. This section includes the following:
   1. Gypsum board attached to metal framing.
   2. Gypsum shaftwall board used in rated ceiling construction as indicated on Drawings.
   3. Gypsum board finishing (joint taping, joint compound and primer).

1.02  RELATED SECTIONS

A. Section 07 92 00 – Joint Sealants.
B. Section 09 22 00 – Metal Support Assemblies

1.03  REFERENCES

F. ASTM E 413 - Classification for Rating Sound Insulation; 2010.
G. GA-214 - Recommended Levels of Gypsum Board Finish; Gypsum Association; 2010.

1.04  SYSTEM DESCRIPTION

A. Acoustic Attenuation for Interior Partitions Indicated as Acoustic: STC of 45-49 calculated in accordance with ASTM E 413, based on tests conducted in accordance with ASTM E 90.

B. Shaft Wall: Configure and install components as required to achieve the following performance levels:
   1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E 413, based on tests conducted in accordance with ASTM E 90.

1.05  SUBMITTALS

-GYPSUM BOARD
09 23 00-1
A. Comply with pertinent provisions of Section 01 33 00.
B. Product Data: Submit manufacturer’s product data for each product specified.

1.06 QUALITY ASSURANCE
A. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.
B. Fire-Resistance Ratings: Comply with fire-resistance ratings as shown and as required by governing authorities and codes. Provide materials, accessories and application procedures which have been listed by UL or tested according to ASTM E 119 for the type of construction shown.
C. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum three years of documented experience.

1.07 DELIVERY AND STORAGE
A. Deliver materials in original packages, containers or bundles, bearing name of manufacturer and brand.
B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

1.08 PROJECT CONDITIONS
A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer’s recommendations, whichever are more stringent.
B. Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 deg F. For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F for 48 hours before application and continuously after until dry. Do not exceed 95 deg F when using temporary heat sources.
C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

PART 2 PRODUCTS

2.01 GYPSUM BOARD PRODUCTS
A. Provide Gypsum Wallboard, ASTM C 36, in assemblies as indicated in Section 09 22 00, and as follows:
   1. Regular Type: For use at vertical surface and ceiling, unless otherwise indicated.
      a. Width: 48 inches.
      b. Thickness: 5/8 inch except where otherwise indicated.
      c. Edges: Tapered.
   2. Fire Resistant Type: complying with Type X requirements; UL or WH rated.
      a. At Assemblies indicated with fire-rating: Use type required by indicted tested assembly; if no tested assembly is indicated use Type X.
      b. Edges: Tapered.
B. Gypsum Shaftwall or Coreboard: ASTM 1396/C1396M; Type X core; sizes to minimize joints in place; 1-inch thick; square, tongue and groove or double beveled edges, ends square cut.

2.02 TRIM ACCESSORIES
A. Accessories for Interior Installation: Cornerbead, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:
   1. Material: Steel sheet zinc coated by hot-dip process or rolled zinc.
   2. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:
      a. Cornerbead on outside corners, unless otherwise indicated.
      b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.
      c. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead where indicated.

2.03 JOINT TREATMENT MATERIALS
A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.
B. Joint Tape for Gypsum Board: 2-inch wide, coated glass fiber tape by joints and corner, except as otherwise indicated.
C. Setting-Type Joint Compounds for Gypsum Board: Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated.
   1. Where setting-type joint compounds are indicated as a taping compound only or for taping and filling only, use formulation that is compatible with other joint compounds applied over it.
   2. For prefilling gypsum board joints, use formulation recommended by gypsum board manufacturer.
   3. For filling joints and treating fasteners of water-resistant gypsum backing board behind base for ceramic tile, use formulation recommendation by gypsum board manufacturer.
   4. For topping compound, use sandable formulation.
D. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

2.04 SEALANTS
A. Acoustical Sealants
   2. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, non-hardening, non-skinning, non-staining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.
   3. Products: Subject to compliance with requirements, provide one of the following, or approved equal:
      b. Acoustical Sealant for Concealed Joints: BA-98; Pecora Corp.; Tremco Acoustical Sealant; Tremco, Inc.
B. Expanding Foam Sealant: Class 1 fire retardant polycell expanding foam by Macklanburg Duncan.
C. Cementitious sealant: Spray-applied (40 pcf) Monokote Z-146.
D. Sheet caulking for junction boxes: "Lowery's Electrical Box Sealer" or Tremco sheet caulking.
E. Sheet caulking for junction boxes at fire-rated assemblies: "Firestop Putty Pads" by Hevi-
duty/Nelson; Specified Technologies, Inc.; or HILTI CP-617.

2.05 MISCELLANEOUS MATERIALS
A. General: Provide auxiliary materials for gypsum drywall work of the type and grade recommended by the manufacturer of the gypsum board.
B. Gypsum Board Nails: ASTM C 514.
C. Steel Drill Screws: ASTM C 1002, for the following applications:
   1. Fastening gypsum board to wood members where indicated.
D. Acoustical Insulation: As specified in Section 07210.

PART 3 EXECUTION

3.01 INSTALLATION OF GYPSUM BOARD
A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.
B. Gypsum Board Installation: Apply first to ceilings, then to walls horizontally. Use board of maximum practical lengths. Stagger end joints. Cut or saw all openings. Do not score and punch. Apply metal edge to all exposed edges and outside corners.
   1. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
   2. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
   3. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
   4. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
      a. Seal perimeter of shaft wall and penetrations with acoustical sealant.
C. Where sound-insulated wallboard work is indicated, seal the work at perimeters, control and expansion joints, openings and penetrations with a continuous bead of acoustical sealant including a bead at both faces of partitions. Comply with manufacturer's recommendations for location of beads, and close off sound-flanking paths around or through the work, including sealing of partitions above acoustical ceilings.
D. Installation on Metal Framing: Use screws for attachment of all gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive laminations permitted under testing agency testing. Use fasteners in accordance with Title 24, Part 2, Table 25A-G for single ply and Table 25A-H for two-ply application.
E. Acoustical Tile Base: Where gypsum panels form the base for adhesively applied acoustical tile, install gypsum wallboard panels with tapered edges taped and finished to produce a flat surface.

3.02 PENETRATIONS (through Sound-Rated Construction).
A. Cut-outs are to be regular and not fracture core or tear covering of gypsum board and meet the following requirements.
B. Minimize penetrations of insulated wall and ceiling constructions. Penetrate only where necessary and fully seal airtight at the perimeter using acoustical sealant.
C. Where ducts and piping greater than 3-inches diameter penetrate insulated wall or ceiling construction, provide a clearance of 1-inch t 1/4-inch at the perimeter of the penetration.

D. Where conduit piping 3-inches diameter and less (including mechanical, hydraulic, plumbing, etc.) pass through insulated wall or ceiling construction, provide a clearance of 1/4-inch t 1/8-inch between the conduit or piping and the structure, unless otherwise shown.

E. After the ductwork, conduit or piping has been installed, repair the gypsum board perimeter clearance to the specified tolerance as required. Where the clearance exceeds 3/4-inch, provide a sheet metal sleeve within the partition packed with safing insulation batts and caulk both sides airtight with an acoustical sealant. Where the perimeter clearance exceeds 3/8-inch, use a flexible backing rod to caulk against.

F. Where penetration clearances are 3/8-inch or less, caulk airtight with acoustical sealant at gypsum board.

G. All gypsum board penetrations (including those resulting from wiring, cables, and electrical junction boxes) are to be sealed airtight with acoustical sealant.

H. The back and sides of junction boxes in sound-rated construction must be sealed airtight with sheet caulking. Caulk perimeter face at gypsum board with acoustical sealant.

I. Recessed panel boards, equipment, boxes, etc. with penetration area greater than 25 sq. in. at sound-rated partitions are to be fully enclosed and sealed with 5/8-inch thick gypsum board or 2 psf sheet lead.

J. Seal multiple conduit penetrations airtight with expanding fire foam sealant.

K. Seal other sound-rated conditions with spray-applied (40 pcf) cementitious sealant equal to Monokote Z-146.

3.03 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer’s directions for type, length, and spacing of fasteners.

B. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

C. Corner Beads: Install at external corners, using longest practical lengths.

D. Edge Trim: Install where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound.
  1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
  2. Install L-bead where edge trim can only be installed after gypsum panels are installed.

3.04 FINISHING OF GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fasteners heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.


C. The finished drywall shall present a smooth, unblemished, homogenous appearance with inconspicuous joining between boards and no visible fasteners. There shall be no areas of raised fibers on the face paper due to over sanding. Visible nail pops, scam lines and cracks within the first year will be corrected as required by the guarantee.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes. Prefill open joints, rounded or beveled edges, and damaged areas using

GYPSUM BOARD
09 23 00-5
setting-type joint compound.
1. Feather coats of joint compound so that camber is maximum 1/32 inch.

E. Apply joint tape over gypsum board joints, except those with trim accessories having flanges not requiring tape.

F. Use the following joint compound combination as applicable to the finish levels specified:

G. Finish gypsum board in scheduled areas in accordance with levels defined in ASTM C 840 and as scheduled below.
1. Above Finished Ceilings Concealed From View: Level 1.
2. Utility Areas and Areas Behind Cabinetry: Level 2.
3. Walls and Ceilings to Receive Flat or Eggshell Paint Finish: Level 4.

H. Where Level 5 finish is indicated, spray apply high build drywall surferc over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

I. Where Level 3 gypsum board finish is indicated, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories; and apply a thin, uniform skim coat of joint compound over entire surface. For skim coat, use joint compound specified for third coat, or a product specially formulated for this purpose and acceptable to gypsum board manufacturer. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects, tool marks, and ridges and ready for decoration.

J. Where Level 1 gypsum board finish is indicated, embed tape in joint compound.

3.06 FINISH LEVEL SCHEDULE (PER GA-214)

A. Level 1
1. Ceiling plenum Areas, concealed areas, janitor closets and where indicated.
2. General:
   a. All joints and interior angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.

B. Level 2
1. Areas behind fixed cabinetry.

C. Level 3
1. Utility spaces including electrical rooms and mechanical rooms.
2. Storage rooms, not including room

D. Level 4
1. Individual offices
2. Walls and ceilings scheduled to receive flat or eggshell paint finish.
3. General:
   a. All joints and interior angles shall have tape embedded in joint compound and 3 separate coats of joint compound applied over all joints, angles, fastener heads and accessories. All joint compound shall be smooth and free of tool marks and ridges.
   b. Gloss, semi-gloss and enamel paints are not recommended over this level of finish.

D. Level 5
1. Gypsum Board Ceilings
2. Walls and ceiling scheduled to receive semi-glass, gloss, enamel or non-textured flat paint.
3. All areas not noted above
4. General:
   a. All joints and interior angles shall have tape embedded in joint compound and 3 separate coats of joint compound applied over all joints, angles, fastener heads and accessories. A thin skim coat of joint compound or a material manufactured especially for this purpose, shall be applied to entire surface. Surface shall be smooth and free of tool marks and ridges.

3.07 CLEANING AND PROTECTION

   A. Promptly remove any residual joint compound from adjacent surfaces.

   B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of completion.

END OF SECTION
SECTION 09 24 00

CEMENT PLASTERING

Fiber Reinforced Three-Coat Stucco with Secondary Water-Resistive Barrier, Enhanced Crack-Resistance, and Smooth Specialty Finish Coat

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Three-coat Portland Cement Stucco assembly with water-resistive barrier sheet, fiber reinforced basecoat, reinforced leveling coat, sandable smoothing coat, tinted primer, metallic finish coat, and clear sealer.

1.2 RELATED SECTIONS
A. Section 07 62 00 - Sheet Metal Flashing and Trim
B. Section 07 92 00 - Joint Sealants
C. Section 09 23 00 - Gypsum Board

1.3 REFERENCES
A. ASTM C578 Specification for Preformed, Cellular Polystyrene Thermal Insulation
B. ASTM C847 Standard Specification for Metal Lath
D. ASTM C926 Standard Specification for Application of Portland Cement-Based Plaster
F. ASTM C1032 Standard Specification for Woven Wire Plaster Base
G. ASTM C1063 Standard Specification for Installation of Lathing and Furring for Portland Cement Based Plaster
H. ASTM E84 Test Method for Surface Burning Characteristics of Building Materials
I. ICC Acceptance Criteria 219 Acceptance Criteria for Exterior Insulation And Finish Systems
J. UUB 790A Specification for Building Paper

1.4 ASSEMBLY DESCRIPTION
A. Parex Armourwall 300 WaterMaster Krak-Shield Stucco Assembly: A code compliant, water-resistive barrier sheet, wire fabric or metal lath, fiber reinforced scratch and brown coat (3/4 in (19 mm)), reinforcing mesh embedded in a copolymer based cementitious leveling coat, sandable smoothing coat, tinted primer, metallic finish coat and clear sealer.

1.5 SUBMITTALS
A. General: Submit samples, water resistive barrier Evaluation Reports and manufacturer's product data sheets in accordance with Division 1 General Requirements Submittal Section.
B. Samples: Submit samples for approval. Samples must be of materials specified and of suitable size as required to accurately represent each color and texture used on the project. Prepare each sample using the same tools and techniques as will be used for actual project application. Maintain and make available at the job site approved samples.
C. Manufacturer's Warranty: Submit sample copies of manufacturer's warranty indicating single source responsibility for stucco assembly materials, including liquid-applied air & water-resistive barrier, base coat, reinforced level coat, smoothing coat, tinted primer, metallic coating clear sealer as

CEMENT PLASTERING
09 24 00-1
specified.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Must have marketed stucco assemblies in the United States for at least ten years and must have completed projects of the same general scope and complexity.

2. Applicator: Must be experienced and competent in installation of fluid-applied air & moisture barriers, stucco materials and specialty finishes, and hold a current certificate of education from the stucco manufacturer. Must provide evidence of a minimum of five years experience in work similar in size & scope to that required by this section.

B. Functional Criteria:

1. General: Stucco application must be to vertical substrates or to substrates sloped for positive drainage according to ASTM C926. Substrates sloped for drainage must have additional protection from weather exposure that might be harmful to material performance.

2. Performance Requirements of Water Resistant Barrier Coating:

<table>
<thead>
<tr>
<th>Weatherseal Testing</th>
<th>Method</th>
<th>ICC and ASTM E2570 Criteria</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerated Weathering</td>
<td>AC 212</td>
<td>25 Cycles followed by Hydrostatic Pressure Test: No water penetration on the plane of the exterior facing side of the substrate.</td>
<td>Pass: no water penetration</td>
</tr>
<tr>
<td>Air Infiltration</td>
<td>ASTM E2178</td>
<td>Calculated flow Rate at 75 Pa (1.57 lb/ft², 0.3 in H₂O) = &lt; 0.02 L/m²/s (&lt; 0.004 cfm/ft²)</td>
<td>&lt; .00001 L/m²/s (0.00001 cfm/ft²) at 75 Pa (1.57 lb/ft², 0.3 in H₂O)</td>
</tr>
<tr>
<td>Air Leakage</td>
<td>ASTM E283</td>
<td>No Criteria</td>
<td>&lt; 0.004 cfm/ft²</td>
</tr>
<tr>
<td>Air Infiltration</td>
<td>ASTM E2178</td>
<td>Calculated flow Rate at 75 Pa (1.57 lb/ft², 0.3 in H₂O) = &lt; 0.02 L/m²/s (&lt; 0.004 cfm/ft²)</td>
<td>&lt; .00001 L/m²/s (0.00001 cfm/ft²) at 75 Pa (1.57 lb/ft², 0.3 in H₂O)</td>
</tr>
<tr>
<td>Air Leakage of Air Barrier Assemblies</td>
<td>ASTM E2357</td>
<td>Pass &lt; 0.2 L / s m² at 75 Pa (&lt; 0.04 cfm / ft² at 1.57 psf)</td>
<td>Pass</td>
</tr>
<tr>
<td>Elongation</td>
<td>ASTM D412</td>
<td>No Criteria</td>
<td>360%</td>
</tr>
<tr>
<td>Flexibility</td>
<td>ASTM D522</td>
<td>No Criteria</td>
<td>No Cracking at 1/8&quot; (3 mm)</td>
</tr>
<tr>
<td>Freeze-Thaw Resistance</td>
<td>ASTM E 2485</td>
<td>10 Cycles</td>
<td>Pass – No Deleterious Effects</td>
</tr>
<tr>
<td>Hydrostatic Pressure Test</td>
<td>AATCC 127 (Water Column)</td>
<td>Resist 21.6 in (55 cm) water for 6 hours before and after aging</td>
<td>Pass: no water penetration</td>
</tr>
<tr>
<td>Nail Seal ability, Head of Water</td>
<td>ASTM D1970</td>
<td>No Criteria</td>
<td>Pass 5 inches of water</td>
</tr>
<tr>
<td>Racking</td>
<td>ASTM E72</td>
<td>Deflection at ¼ in (3.2 mm)</td>
<td>Pass - No cracking at field, joints or flashing connection</td>
</tr>
<tr>
<td>Restrained Environmental</td>
<td>ICC E5 AC 212 / ASTM E2570</td>
<td>5 Cycles of wetting and drying</td>
<td>Pass - No cracking at field, joints or flashing connection</td>
</tr>
<tr>
<td>Structural Loading</td>
<td>ASTM E1233 Procedure A</td>
<td>10 Cycles @ 80% design load</td>
<td>Pass - No cracking at field, joints or flashing connection</td>
</tr>
<tr>
<td>Surface Burning Characteristics</td>
<td>ASTM E84</td>
<td>ICC and ASTM E2568 Flame Spread &lt;25 Smoke Developed &lt;450</td>
<td>Flame Spread = 0 Smoke Developed = 0</td>
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<tr>
<td>Tensile Bond Strength</td>
<td>ASTM E 2134/ ASTM C 297</td>
<td>Minimum 15 psi (104 kPa)</td>
<td>Pass all listed substrates and flashing materials</td>
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<tr>
<td>Water Resistance</td>
<td>ASTM D 2247</td>
<td>14 Days</td>
<td>Pass – No Deleterious Effects</td>
</tr>
<tr>
<td>Water Penetration</td>
<td>ASTM E331</td>
<td>2.88 psf (137 Pa) for 15 minutes</td>
<td>Pass 25.4 psf (1216 Pa) for 165 minutes</td>
</tr>
</tbody>
</table>

Water Penetration ASTM E331 Tested after Structural Loading, Racking and Restrained Environmental No Water Penetration
<table>
<thead>
<tr>
<th>Water vapor transmission</th>
<th>ASTM E96 Procedure B</th>
<th>Cycling at 2.66 psf (137 Pa) for 15 minutes</th>
<th>Vapor Permeable</th>
<th>12. perms</th>
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</thead>
<tbody>
<tr>
<td>Weathering</td>
<td>ICC ES AC 212 / ASTM E2570</td>
<td>210 hours of UV Exposure, 25 cycles of accelerated weathering, 21.6 in (549 mm) water column for 5 hours</td>
<td>Pass</td>
<td></td>
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<tr>
<td>Wind Driven Rain</td>
<td>F.S. TT-C-555B</td>
<td>No Criteria</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>VOC</td>
<td>EPA Reference Test Method 24</td>
<td>US EPA, South Coast AQMD and Greenbuild Standard</td>
<td>10 g/L</td>
<td></td>
</tr>
<tr>
<td>Regional Harvest</td>
<td>LEED MRc 5.1</td>
<td>100% at all facilities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Performance Requirements of Coatings applied to Expanded polystyrene features: Must comply with ASTM E2568 or ICC Acceptance Criteria AC 219 for EIFS.

C. Substrate Conditions:
   1. Substrate materials and construction must conform to the building code having jurisdiction.
   2. Substrates must be sound, dry and free of dust, dirt, laitance, efflorescence and other harmful contaminants.
   3. Substrate Dimensional Tolerances: Flat with 1/4 in (6.4 mm) within any 10 ft (3 m) radius.
   4. Maximum deflection of substrate system under positive or negative design loads must not exceed L/360 of span.

D. Expansion and Control Joints: Continuous expansion and control joints must be installed at locations in accordance with ASTM C1063 and ASTM C926.
   1. Substrate movement, and expansion and contraction of stucco and adjacent materials must be taken into account in design of expansion joints, with proper consideration given to sealant properties, installation conditions, temperature range, coefficients of expansion of materials, joint width to depth ratios, and other material factors. Minimum width of expansion joints must be as specified by the designer or shown on the project drawings.
   2. In accordance with ASTM C1063, expansion or control joints must be installed in walls not more than 144 ft² (13.4 m²) in area, and not more than 100 ft² (9.3 m²) in area for all non-vertical applications. The distance between joints must not exceed 18 ft (5.5 m) in either direction or a length-to-width ratio of 2-1/2 to 1.
   3. For direct application to concrete or masonry, stucco joints are required only at control/expansion joints in the underlaying concrete or masonry.

1.7 DELIVERY, STORAGE, AND HANDLING
   A. Delivery: Deliver stucco assembly products in original packaging with manufacturer's identification.
   B. Storage: Store stucco assembly products in a dry location, off the ground, protected from moisture.

1.8 SITE / ENVIRONMENTAL CONDITIONS
   A. Substrate Temperature: Do not apply stucco assembly products to substrates whose temperature are below 40°F (4°C) or contain frost or ice.
   B. Inclement Weather: Do not apply stucco materials during inclement weather, unless appropriate protection is employed.
   C. Sunlight Exposure: Avoid, when possible, installation of the stucco materials in direct sunlight. Application of finishes in direct sunlight in hot weather may adversely affect aesthetics.
   D. Do not apply stucco base coats or finishes if ambient temperature falls below 40°F (4°C) within 24 hours of application. Protect stucco from uneven and excessive evaporation during dry weather and strong blasts of dry air.
   E. Prior to installation, the wall must be inspected for surface contamination, or other conditions that
may adversely affect the performance of the stucco materials and must be free of residual moisture.

1.9  COORDINATION AND SCHEDULING:
A. Coordination: Coordinate stucco assembly installation with other construction operations.

1.10  WARRANTY
A. Warranty: Upon request, at completion of installation, provide manufacturer’s Standard Limited Stucco Assembly Warranty.

PART 2 - PRODUCTS

2.1  MANUFACTURER
   1. Parex, Anaheim, CA
   2. Lahabra Stucco, Anaheim, CA
   3. El Rey Stucco, Albuquerque, NM
B. Components: Obtain stucco assembly components manufactured by Parex USA from authorized distributors. No substitutions or additions of other materials are permitted without prior written permission from the manufacturer for this project.

2.2  MATERIALS
A. Air & Water-Resistive Barrier
   1. Parex USA WeatherSeal Spray & Roll-On water resistive barrier coating. Two coats are required on plywood and OSB.
   2. Parex USA 396 Sheathing Tape: Non-woven synthetic fiber tape to reinforce WeatherSeal water-resistive barrier membrane at sheathing board joints, into rough openings and other terminations into dissimilar materials.
   3. Parex USA WeatherSeal Spray & Roll-On water resistive barrier coating is covered by an intervening material such as building paper, See Section 2.3 C.
B. Stucco Scratch & Brown Materials
   1. Fiber-47 300 Stucco Assembly
C. Leveling and Reinforcing Coat Materials
   1. Parex 121 Dry Base Coat: Copolymer based, factory blend of cement and proprietary ingredients requiring addition of water.
   2. Parex 355 Standard Mesh: Weight 4.5 oz/yd2 (153 g/m2) reinforcing mesh.
D. Sandable Smoothing Coat
   1. Parex USA Sandable Basecoat: 100% acrylic, sandable basecoat for use on interior and exterior surfaces used to obtain smooth finish levels suitable for metallic finishes.
E. Primer
1. Parex USA 310 Primer: 100% acrylic based, tintable coating used to prepare surfaces for acrylic, elastomeric or specialty finishes.

F. Finish Coating
1. Parex USA Smooth Metallic Coating: 100% acrylic-based specialty finish with DPR (dirt pick-up resistance) characteristics. Finish type, texture and color as selected by Project Designer.
   a. Texture: Smooth
   b. Color: Custom Color to match Metal Panel by Kingspan: Champagne Bronze (Mica)

G. Sealer
1. Clear Sealer: Parex USA 610 Clear Sealer: 100% acrylic transparent sealer designed to provide additional UV protection & cleanability.

2.3 RELATED MATERIALS AND ACCESSORIES
A. General: Stucco assembly and related materials must conform to ASTM C926, this specification and manufacturer’s product data sheets and technical bulletins.

B. Substrate Materials:
1. Substrate must be gypsum sheathing, cement board, fiberboard, plywood, OSB, concrete, concrete masonry or other sheathing allowed by the application building code.

2. The sheathing must be in compliance with the building code having jurisdiction.

3. Refer to Related Sections for project requirements.

C. Water-Resistive Barriers:
1. 2 layers of Type I Grade D, Style 2 vapor-permeable paper
   (i) Basis of Design: Fortifiber Corp Two-Ply super Jumbo Tex, 60 minute or equal
   2. Other recognized equivalent.

D. Lath and Accessories: Conform to ASTM C847, ASTM C933, ASTM C1032 and ASTM C1063 and Appendix.
1. Accessories: Manufacturer’s standard steel products with minimum G60 galvanizing unless otherwise indicated as zinc alloy.

2. Metal Plaster Bases: Minimum 17 gauge self-furred stucco netting, welded wire lath in accordance with applicable codes and standards.
   a. Basis of Design: Structa Wire Corp – Structalath No. 17 1 ½” x 1 ½” SF CR II

3. Weep Screeds: Foundation weep screed with minimum 3-½ inch vertical attachment flange.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify project site conditions under provisions of Section 01 00 00.

B. Compliance: Comply with manufacturer’s instructions for installation of stucco assembly materials.

C. Substrate Examination: Examine prior to stucco installation as follows:
1. OSB substrates must be gapped 1/8 in (3.2 mm) at all edges.

2. Substrate must be examined for soundness, and other harmful conditions.

3. Substrate must be free of dust, dirt, laitance, efflorescence, and other harmful contaminants.

4. Substrate construction in accordance with substrate material manufacturer’s specifications and applicable building codes.

D. Advise Contractor of discrepancies preventing installation of the stucco assembly. Do not proceed with the stucco assembly work until unsatisfactory conditions are corrected.
E. Ensure that flashing has been installed per Specification Section 07 62 00-Flashings and Sheet Metal.

3.2 PREPARATION
A. Air & Water Resistive Barrier:
   1. The water-resistive barrier is placed over all substrates except concrete or unpainted masonry. Painted (coated) CMU requires the use of a bond breaker such as asphalt paper and lath if the paint or coating cannot be removed.
   2. Install according to manufacturers instructions.
B. Wire Fabric Lath and Metal Lath: Install according to ASTM C1063 and Appendix and the Building Code.
C. Concrete (Cast-in-Place): Provide a surface that is slightly scarified, water absorbent, straight and true to line and plane. Remove form ties and trim projecting concrete so it is even with the plane of the wall. Remove form release agents.
D. Concrete Masonry Units: Remove projecting joint mortar so it is flush with the plane of the wall. Remove surface contaminants such as efflorescence, existing paint or any other bond inhibiting material by sandblasting, waterblasting, wire brushing, chipping or other appropriate means. Pre-moisten the surface with water just prior to placement of stucco, or apply one uniform coat of bonding agent by brush or roller.

3.3 MIXING
A. Mix pre-blended stucco materials in accordance with manufacturer's instructions, including the applicable stucco assembly product data sheets and technical bulletins.
B. Admix & Bonding Agent
   1. Mix up to 1 gallon per 90 pound bag of Parex Fiber-47 Scratch & Brown Concentrate and up to 1 quart per 80 pound bag of Parex Fiber-47 Scratch & Brown Sanded. Add after dry components and the majority of the water has been mixed. Mix no longer than required to provide a uniform mixture. DO NOT OVER-MIX. Overmixing entrains excessive amounts of air which weaken the material. Do not re-temper mixes over 20 minutes old.

3.4 APPLICATION
A. General: Stucco assembly and related materials must conform to ASTM C926, this specification and the manufacturer's product data sheets.
B. Air & Water Resistive Barrier
   1. Flash all rough openings with WeatherSeal Spray & Roll-On water-resistive barrier and embedded Parex 396 Sheathing Tape.
   2. Treat all sheathing joints with WeatherSeal Spray & Roll-On water-resistive barrier and embedded Parex 396 Sheathing Tape.
   3. Apply WeatherSeal Spray & Roll-On water-resistive barrier to the surface of the substrate (minimum 2 coats on plywood and OSB).
   4. Ensure that the WeatherSeal laps onto all tracks and flashing to allow for any water to be drained into the tracks/flashings.
   5. Install a code approved, water vapor permeable, intervening material such as building paper over the water resistive barrier.
C. Stucco Assembly:
   1. Scratch Coat:
      a. Apply scratch coat to a minimum thickness of 3/8 in (10 mm), using sufficient trowel pressure to key stucco into lath or to create bond to substrates as applicable.

CEMENT PLASTERING
09.24.00-6
b. Prior to initial set, scratch horizontally to provide key for bond of brown coat.

c. Moist cure scratch coat with clean potable water for at least 48 hours in accordance with ASTM C926 and the building codes following initial application (unless brown coat is applied as soon as the scratch coat has achieved sufficient rigidity to support the brown coat).

2. Brown Coat:
   a. Apply brown coat to a minimum thickness of 3/8 in (10 mm), using sufficient trowel pressure to key stucco into scratch coat.
   b. Rod surface to true plane and float to densify.
   c. Trowel to smooth and uniform surface to receive finish coat.
   d. Moist cure brown coat with clean potable water for at least 48 hours, in accordance with ASTM C926 and the building codes.

D. Leveling and Reinforcing Coat
   1. Allow scratch and brown stucco base to dry and moist cure a minimum of 48 hours before applying the leveling and reinforcing coat.
   2. Using a stainless steel trowel, apply the leveling coat over the scratch and brown stucco base at a thickness of 1/16 to 3/32 in (1.6 – 2.4 mm).
   3. Fully embed the reinforcing mesh, either standard mesh or intermediate mesh, into the wet stucco level coat material, including diagonal strips at corners of openings and trowel smooth. Standard mesh seams are overlapped 2-1/2 in (63 mm).
   4. Apply a second thin coat of leveling coat material and allow to dry, then lightly sand.

E. Sandable Smoothing Coat
   1. Apply sandable smoothing coat material according to the product data sheet for smooth finishes.
   2. Trowel apply a thin, even coat of Sandable Basecoat to ensure complete coverage of the substrate and eliminate the reflective appearance of reinforcing mesh. Allow to dry completely.
   3. Sand the surface with 220 grit or finer sand paper to remove high points. Apply a second tight even coat to the smoothest level possible and dry completely. Sand the surface as necessary to achieve the smoothest surface possible.
   4. Before the application of the primer and finish coating, the basecoat must have cured a minimum of 24 hours or longer as required by conditions. Examine the cured base coat for any irregularities. Correct these irregularities to produce a flat surface.

F. Primer
   1. Spray apply tinted primer according to the manufacturer’s published data sheet.

G. Finish Coating
   1. Spray apply metallic coating according to the manufacturer’s published data sheet to match specified finish type, texture, and color.
   2. Allow metallic finish coating to dry a minimum of 24 hours before application of clear sealer.

H. Clear Sealer
   1. Spray apply clear sealer according to the manufacturer’s published data sheet.

F. Curing
   1. Scratch and Brown: Moist cure in accordance with ASTM C926 and the building codes.
   2. Cure leveling and smoothing coats and specialty finish coats in accordance with manufacturer’s published data sheets.

3.5 CLEAN-UP

CEMENT PLASTERING
09 24 00-7
A. Removal: Remove and legally dispose of stucco component debris material from the job site.

3.6 PROTECTION

A. Provide protection of installed materials from water infiltration into or behind them.
B. Provide protection of installed stucco from dust, dirt, precipitation, and freezing during installation.
C. Provide protection of installed finish coats from inclement weather until fully cured and dry.
D. Clean exposed surfaces using materials and methods recommended by the manufacturer of the material or product being cleaned. Remove and replace work that cannot be cleaned to the satisfaction of the Project Designer/Owner.

END OF SECTION
SECTION 09 30 00

TILE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.
B. Tile for wall applications.
C. Stone thresholds.

1.02 RELATED REQUIREMENTS

A. Section 09260 - Gypsum Board Assemblies: Installation of tile backer board.

1.03 REFERENCE STANDARDS


Q. ASTM C 140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2010.


S. ASTM C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading); 2010.


1.04 SUBMITTALS

A. See Section 01330 - Submittal Procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Provide plans and elevations that indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 x 18 inches in size illustrating pattern, color variations, and grout joint size variations.

E. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01600 - Product Requirements, for additional provisions.
   2. Extra Tile: 10 square feet of each size, color, and surface finish combination.

1.05 QUALITY ASSURANCE


B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.

C. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not install adhesives in an unventilated environment.

B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

1.08 WARRANTY
A. The Contractor warrants the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for a period of 25 years. The manufacturer of adhesives, mortars, grouts and other installation materials shall provide a written twenty five (25) year warranty, which covers materials and labor - reference LATICRETE Warranty Data Sheet 025.0 for complete details and requirements. For exterior facades over steel or wood framing, the manufacturer of adhesives, mortars, grouts and other installation materials shall provide a written ten (10) year warranty, which covers replacement of LATICRETE products only - reference LATICRETE Warranty Data Sheet 230.15 for complete details and requirements.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers: All products by the same manufacturer.
   2. Substitutions: Not permitted.

B. Ceramic Mosaic Tile: ANSI A137.1, and as follows:
   1. See Finish Schedule for specific tile and color.
   2. Moisture Absorption: 0 to 0.5 percent.
   5. Trim Units: Matching bead, cove, and surface bullnose shapes in sizes coordinated with field tile.

C. Glazed Wall Tile: ANSI A137.1, and as follows:
   1. See Finish Schedule for specific tile and color.
   2. Moisture Absorption: 3.0 to 7.0 percent.
   3. Trim Units: Matching bead, bullnose, cove, and base shapes in sizes coordinated with field tile.

2.02 TRIM AND ACCESSORIES

A. Thresholds: Marble, black Carerra, honed finish; 2 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radius corners on top side; without holes, cracks, or open seams.
   1. Applications: Provide at the following locations:
      a. At doorways where tile terminates.
      b. At open edges of floor tile where adjacent finish is a different height.

2.03 ADHESIVE MATERIALS

A. Manufacturers:
   2. Substitutions: See Section 01625 - Product Options and Substitutions.

2.04 MORTAR MATERIALS

A. Manufacturers:
   2. Substitutions: See Section 01625 - Product Options and Substitutions.

B. Cementitious Bond Coat Materials:
1. Latex-Portland Cement type: ANSI A118.4.

2.05 GROUT MATERIALS

A. Premium-grade premixed sanded Portland cement tile grout complying with ANSI A118.6 and having specifically tailored, proprietary, integrally-mixed antimicrobial agent.
   1. Colors: To be selected by Architect from manufacturer's standard range.

B. Manufacturers:

2.06 ACCESSORY MATERIALS

A. Cleavage Membrane: No. 15 asphalt saturated felt.

B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
   2. Manufacturers:
      b. Substitutions: See Section 01625 - Product Options and Substitutions.

C. Reinforcing Mesh: 2 x 2 inch size weave of 16/16 wire size; welded fabric, galvanized.


E. Grout Sealer: Provide as recommended by tile manufacturer.

F. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as indicated.

G. Water: Fresh, clean, clear potable water from a domestic source complying with ASTM C 94 and free of oil, grease, waxy films, curing compounds, release agents and other deleterious materials, including salts, acids, alkalis, organic materials, detergents or other matter, which might negatively affect plaster quality, strength, durability or performance or which might interfere with plaster curing, color or appearance.

H. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of
setting materials to sub-floor surfaces.

D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

C. Vacuum clean surfaces and damp clean.

D. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

E. Install tile backer board in strict accordance with manufacturer's instructions, using galvanized roofing nails or corrosion-resistant bugle head drywall screws. Bed fiberglass self-adhesive tape at all joints and corners with material used to set tiles.

F. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer’s instructions, and The Tile Council of North America Handbook recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

E. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

F. Form internal angles square and external angles bullnosed.

G. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep expansion joints free of adhesive or grout. Apply sealant to joints.

J. Allow tile to set for a minimum of 48 hours prior to grouting.

K. Grout tile joints. Use standard grout unless otherwise indicated.

L. Grout Sealer: Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.
M. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with The Tile Council of North America Handbook Method F113A, with standard grout, unless otherwise indicated.
   1. Where waterproofing membrane is indicated, install in accordance with The Tile Council of North America Handbook Method F122A, with latex-Portland cement grout.
      a. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.05 INSTALLATION - FLOORS - MORTAR BED METHODS

A. Tile over interior concrete substrates, install in accordance with The Tile Council of North America Handbook Method F111, cleavage membrane, unbonded, unless otherwise indicated.
   1. Where waterproofing membrane is indicated, with standard grout or no mention of grout type, install in accordance with The Tile Council of North America Handbook Method F121.

B. Expansion Joints: Provide in accordance with TCNA EJ171. Provide 1 expansion joint in each direction in the middle of the room

C. Mortar Bed Thickness: 1-1/4 inch min, unless otherwise indicated.

3.06 INSTALLATION - WALL TILE

A. Over cement backer board on metal studs, install in accordance with The Tile Council of North America Handbook Method W244C, using waterproof membrane at toilet room walls.

3.07 INSTALLATION - WALL TILE on CONCRETE

A. Over Concrete, install in accordance with The Tile Council of North America Handbook Method W202I.

B. Concrete wall requires to be bush hammered or sandblasted to facilitate bonding.

3.08 CLEANING

A. Clean tile and grout surfaces.

3.09 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION
SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

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

1.02 SECTION INCLUDES
A. Rubber Wall Base – straight for concrete floor installations and coved for carpet installations.

1.03 RELATED SECTIONS
A. Section 09 68 13 – Carpet Tile
B. Section 09 23 00 – Gypsum Board

1.04 SUBMITTALS
A. Product Data: Manufacturer’s published literature for each resilient accessory.
B. Certificates: For for-rated materials and ADA compliance.
C. Samples: Provide 8-inch sample of each resilient accessory.

1.05 PROJECT SITE CONDITIONS
A. Store at job site in a dry place at least 48 hours before installation.
B. Install only when room temperature is within range specified by manufacturer. Maintain temperature until 24 hours after completion.

PART 2 - PRODUCTS

2.01 MANUFACTURER
A. Acceptable Manufacturers: Burke Flooring, or approved equal.
B. Substitutions: See Section 01 60 00 – Product Requirements and Substitutions

2.02 WALL BASE
A. Thermoset Rubber Base: BurkeBase Type TS
   1. Molded Thermoset (vulcanized) rubber, 1/8 in. thickness, satin finish; ASTM F1861, Type TS, Group 1, Styles A & B. Provide pre-molded corners.
   3. Color: #217 Charcoal. Select from manufacturer’s standard color array.
   4. Profile:
      a. Cove base for carpet installation.
      b. Straight base for installation at concrete floors
   5. Size: 4 inch high.
2.03 ACCESSORY MATERIALS
   A. Adhesive: Resilient accessories manufacturer's required adhesive, suitable for each individual product, substrate, and location.
   B. Concrete Slab Primer: Non-staining type as required by resilient accessories manufacturer.
   C. Leveling and Underlayment Compound: Latex cementitious type as required by resilient accessories manufacturer, having a minimum density of 4000 lbs per sq. ft. after 28 days.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL
   A. Pursuant to manufacturer's published instructions and RFCI "Recommended Work Procedures for Resilient Floor Coverings".
   B. Lay materials true to line, level, and with tight joints. Cut materials to and around permanent fixtures, equipment and bases. Roll installation pursuant to manufacturer's published instructions.
   C. Firmly adhere resilient base materials to walls and permanent fixtures. Scribe and fit bases accurately to abutting surfaces.
   D. After installation, remove excessive adhesive pursuant to resilient material manufacturer's published instructions.

3.02 CLEANING
   A. Clean resilient materials pursuant to manufacturers published instructions.

END OF SECTION
SECTION 09 67 00

FLUID-APPLIED FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fluid-applied exterior flooring.

1.2 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Joint between base and wall surface.

1.3 REFERENCE STANDARDS

1.4 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.

C. Samples: Submit two samples, 8 x 10 inch in size illustrating color and pattern for each floor material for each color specified.

D. Manufacturer's Installation Instructions: Indicate special procedures.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Applicator Qualifications: Company specializing in performing work of this section with minimum three years' experience.

C. Supervisor Qualifications: Trained by product manufacturer, under direct full time supervision of manufacturer's own foreman.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store resin materials in a dry, secure area.

B. Store materials per manufacturer's instructions.

1.7 FIELD CONDITIONS
A. Maintain minimum temperature in storage area of 55 degrees F.

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fluid-Applied Flooring:
   1. Basis of Design: STONHARD; www.stonhard.com
   2. Substitutions: See Section 01640 - Product Options and Substitutions for procedures.

2.2 MATERIALS

A. Fluid-Applied Flooring: Polyurethane, four component system.
   1. Exterior application:
      a. STONSET TG6: four component polyurethane based grout system.
      b. STONCLAD UR: four component polyurethane mortar system.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.

C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of materials to sub-floor surfaces.

D. Verify that concrete sub-floor surfaces are ready for flooring installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by flooring materials manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

A. Exterior Applications (at aprons):
   1. Saw-cut and bush-hammer to accommodate ¼” minimum leveling material thickness.
   2. In other areas, grind floor to mechanical prep CSP2 (ICRA Standard).

3.3 INSTALLATION - FLOORING

A. Apply in accordance with manufacturer's instructions.
B. Apply each coat to minimum thickness indicated.

3.4 PROTECTION

A. Prohibit traffic on floor finish for 48 hours after installation.

B. Barricade area to protect flooring until cured.

END OF SECTION
SECTION 09 68 13

CARPET TILE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.02 REFERENCE STANDARDS


B. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2009.

C. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; Current Edition.

1.03 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures.

B. Shop Drawings: Indicate layout of joints and pattern layout as specified.

C. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

E. Submit two, 12 inch long samples of edge strip.

F. Manufacturer's Installation Instructions: Indicate special procedures.

G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements and Substitutions, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet with minimum three years experience.

1.05 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS
2.01 MANUFACTURERS

A. InterfaceFlor, Campus standard.
B. Substitutions: Not permitted.

2.02 MATERIALS

A. Carpet Tile Type CA-1: Tufted, manufactured in one color dye lot.
   1. Product: Velveteen manufactured by Interface Flor.
   2. General Requirements:
      a. Product Number: 12367100828
      b. Product Construction: Tufted Cut & Loop.
      c. Soil/Stain Protection: Protekt®.
      d. Antimicrobial Treatment: (AATCC 138 Washed) (AATCC 174 Parts 2&3) Intersept®.
      e. Yarn System: Post-Consumer Content Type 6,6 Nylon.
      f. Yarn Manufacturer: Universal.
      g. Dye Method: 100% Solution Dye.
      h. Post-Industrial Recycling Content: 32% - 35%.
      i. Post-Consumer Recycling Content: 30%.
      j. Total Recycled Content: 62% - 65%.
   3. Product Specifications:
      a. Tile Size: 50 cm by 50 cm nominal.
      b. Tufted Yarn Weight: 24 oz/sq yd.
      c. Pile Thickness: 0.163 inches.
      d. Pile Height: 0.21 inches.
      e. Pile Density: 5301.
      g. Machine Gauge: 5/64 inch.
      h. Layout Pattern: Quarter-Turn
   4. Performance Requirements:
      a. Indoor Air Quality: Green Label Plus Certified #GLP0820.
      b. Sustainable Carpet Assessment Standard: NSF-140 Platinum.
      d. Smoke Density: (ASTM E - 662).
      e. Lightfastness: (AATCC 16 - E).
      f. Static: (AATCC - 134) < 3 KV.
      g. Standard Backing: GlasBac® Tile.

2.03 ACCESSORIES

A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
B. Edge/Transition Strips: Rubber, color to match rubber base
C. Edge Strips: Rubber, color as selected.
D. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.
   1. Product: Grid-Set Green Glue 2000 manufactured by InterfaceFlor or approved equal.
PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.

C. Verify that concrete sub-floor surfaces are dry enough and ready for flooring installation by use of an Anhydrous Calcium Chloride test for moisture emission rate and alkalinity in accordance with ASTM F 1896; obtain instructions if test results are not within limits recommended by carpet tile manufacturer and adhesive materials manufacturer. Do not proceed with installation if emissions exceed manufacturer’s limitations.

D. Verify that required floor-mounted utilities are in correct location.

E. Remediation:
   1. In the event that moisture and pH conditions are outside specified limit, install MoistureGard 2.0 barrier sheet if recommended by manufacturer over substrate prior to installation of carpet tile. Install system in accordance with manufacturer’s written installation instructions.

3.02 PREPARATION

A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

C. Vacuum clean substrate.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install carpet tile in accordance with manufacturer's instructions and CRI Carpet Installation Standard.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Locate change of color or pattern between rooms under door centerline.

G. Fully adhere carpet tile to substrate.

H. Trim carpet tile neatly at walls and around interruptions.

I. Complete installation of edge strips, concealing exposed edges.
3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION
SECTION 09 84 13

FIXED SOUND-ABSORPTIVE PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fabric-covered fiberglass and polyester core panels and mounting accessories (AP-1, AP-2).
B. Wall Covering.

1.02 SUBMITTALS

A. See Section 01 30 00 – Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer’s printed data sheets for products specified.
C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
D. Verification Samples: Fabricated samples of each type of panel specified; 12 x 12 in., showing construction, edge details, and fabric covering.

1.03 QUALITY ASSURANCE

A. Manufacturer & Installer: Firm manufacturing the specified product shall have adequate capacity required for projects listed and have successfully completed similar projects for a period of not less than five years. The installer should be approved by the manufacturer as qualified to perform work required.

B. Reference Standards: Conform to all governing laws, building codes, and the following performance criteria:
   1. Fire Performance Characteristics: Provide acoustic wall panels with surface-burning characteristics as determined by testing panel components in accordance with ASTM E84 test procedures (building code requirements may necessitate composite panel testing using identical materials and construction representative of a typical installation, using the specified finish(es) – Decoustics has a considerable number of composite ASTM E84 panel tests on file).
      a. ASTM E-84 testing must be performed by a testing organization acceptable to authorities having jurisdiction.

         | ASTM E-84 Classification | Class “A” or “1” |
         | Flame Spread:            | 25 or less       |
         | Smoke Developed:         | 450 or less      |

   2. Acoustical Performance Characteristics: Provide wall panels with acoustical absorption characteristics as indicated in Part 2, which have been determined by testing fully assembled production material in accordance with ASTM C 423 (Type A mounting method as defined by ASTM E-795) by a testing organization acceptable to authorities having jurisdiction. Approved testing organization must be independent of the manufacturer.

   3. Tackable surface where required.

   C. Single Source: All custom acoustical wall and ceiling panels shall be purchased from a single supplier.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical panels from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until panels are needed for installation.
B. Store panels flat, in dry, well-ventilated space; do not stand panels on end.
C. Protect panel edges from damage.
D. Prior to panel installation, the site must be free of all wet and dusty trades and the climatic conditions stabilized to normal operational levels. Panels shall be allowed to stabilize on site 24 hours prior to installation.
E. Panels must only be handled by persons wearing clean light-weight gloves after removing protective coating. It is very important that personnel installing hardware (wall clips, screws, anchors, etc.) do not handle the panels before putting the clean lightweight gloves on.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

   1. Acceptable Manufacturers
      a. Decoacoustics Limited, TEL: (800) 387-3809; www.decoacoustics.com or approved equal.

B. Substitutions: See Section 01 60 00 – Product Requirements and Substitutions.
C. Provide all acoustical panels by one manufacturer.

2.02 ACOUSTICAL WALL PANELS

B. Panel Sizes: as indicated on drawings.
C. Core: (Acoustical Panels, AP-1)
   1. Density: 6-7 lb/cu ft.
   2. Acoustically Absorptive.
   3. Resin hardened edge.
   4. Noise Reduction coefficient (NRC) as follows when tested in accordance with paragraph 1.03 B:

<table>
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<th>Frequency (Hz)</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>4000</th>
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<td>1.09</td>
<td>1.05</td>
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<td>0.87</td>
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5. Core: (Tackable Panel, AP-2)
   1. Density: 7.5per cubic ft.
   2. Polyester acoustical panels “Poly Max.”
   3. Acoustically Absorptive
   4. Resin hardened edge.

6. Panel Thickness: 1 in.
7. Edges: Perimeter edges reinforced by an aluminum frame, a galvanized steel frame. As noted in drawings.
10. Flame Spread: Class A, less than 25 in accordance with ASTM E84.

D. Fabric Covering: Seamless fabric facing material, for stretched covering of core material.
   1. Fabric: Match existing fabric and color
   2. Color: Match existing fabric and color
3. Patterns: Where fabric with directional or repeating patterns or fabric with directional weave is used, mark for installation in same direction.

2.03 FABRICATION

A. General: Fabricate panels to sizes and configurations indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.
   1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.
B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 in for thickness, overall length and width, and squareness from corner to corner.

2.04 ACCESSORIES

A. Back-Mounting Accessories: Manufacturer’s standard accessories for concealed support, designed to allow panel removal, and as follows:
   1. Two-part clip and base-support bracket system; brackets designed to support full weight of panels and clips designed for lateral support, with one part mechanically attached to back of panel and the other attached to substrate.
   2. Mechanically Mounted Metal-Framed Panels: Metal panel-clip system designed to engage metal framing of panels.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical panels. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical panels in locations indicated, following installation recommendations of panel manufacturer. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.
B. Install panels to construction tolerances of plus or minus 1/16 in for the following:
   1. Plumb and level.
   2. Flatness.
   3. Width of joints.

3.03 CLEANING

A. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer’s instructions.
B. Remove surplus materials, trimmed portions of panels, and debris resulting from installation.

3.04 PROTECTION OF FINISHED WORK

A. Provide protection of installed acoustical panels until completion of the Work.
B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.
SECTION 09 90 00

PAINTING AND COATING

PART 1 - GENERAL

1.01 SUMMARY
   A. Section Includes:
      1. Surface preparation, painting and finishing of exposed interior and exterior items and
         surfaces.
      2. Warning Stripe at each tread of existing exterior stair.
   B. General provisions of the Contract, including General and Supplementary Conditions and
      Division 1 Specification Sections, apply to this Section.
   C. Related Sections
      1. Section 08 13 00 - Steel Doors and Frames: Shop priming steel doors and frames.
      2. Section 08 14 16 - Flush Wood Doors: Shop priming wood doors.
      3. Section 09 23 00 – Gypsum Board.

1.02 SYSTEM DESCRIPTION
   A. Performance Requirements
      1. Paint exposed surfaces whether or not colors are designated in the schedules, except
         where a surface or material is specifically indicated not to be painted or is to remain
         natural.
      2. Painting is not required on pre-finished items, finished metal surfaces, concealed
         surfaces, operating parts and labels.
      3. Do not paint over UL, FM or other code required labels or equipment name,
         identification, performance rating or nomenclature plates.

1.03 SUBMITTALS
   A. See Section 01 33 00 –Submittals for submittal procedures.
   B. Product Data: Submit manufacturer’s product data for each paint system specified,
      including primers.
   C. Samples
      1. Following the selection of colors and glosses by the Architect, submit samples for the
         Architect’s review.
         a. Provide 3 samples of each color and each gloss for each material on which the
            finish is specified to be applied.
         b. Make samples approximately 8 inches by 10 inches in size. Clearly label with
            color designation as listed on Finish Schedule.
         c. If so directed by the Architect, provide field mock-ups during progress of the Work
            in the form of actual application of the materials on actual surfaces to be painted
            for approval by the Architect. Areas shall be 10 feet by 10 feet.
      2. Do not commence finish painting until samples are approved.

1.04 QUALITY ASSURANCE
   A. Provide primers and undercoat paint produced by the same manufacturer as finish coats.
1. Review other Sections of these Specifications as required, verifying the prime coats to be used and assuring compatibility of the total coating system for the various substrates.
2. Provide barrier coats over non-compatible primers, or remove the primer and re-prime as required.
3. Notify the Architect in writing of anticipated problems in using the specified coating systems over prime coatings supplied under other Sections.

1.05 MAINTENANCE
A. Upon completion of the work of this Section, deliver to the District an extra stock equaling 1 gallon of each color, type and gloss of paint used in the Work; tightly sealing each container, and clearly labeling with contents and location where used.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Acceptable Manufacturers: ICI Dulux, Dunn-Edwards, Benjamin Moore, Pratt & Lambert, Tnemec, Rustoleum, Sherwin-Williams, Kelly Moore or equal.

2.02 PAINT MATERIALS
A. Paint Materials General: Provide block fillers, primers, finish coat materials and related materials that are compatible with one another and the substrates.
B. Material Quality: Provide manufacturer's best quality trade sale paint material of the various coating types specified.
C. Colors: (per dwgs)
   4. Metal Color (AESS at metal roof support structure and handrail at exterior stair): Match Frazee 131 Endurable Semi-gloss Acrylic Paint, color: ColorLife #CL 3013M Artesan.

PART 3 - EXECUTION

3.01 PREPARATION
A. General: Mix and prepare paint materials in strict accordance with the manufacturers' recommendations as approved by the Architect.
B. Surface Preparation
   1. General
      a. Perform preparation and cleaning procedures in strict accordance with the paint manufacturers' recommendations as approved by the Architect.
      b. Remove removable items which are in place and are not scheduled to receive paint finish, or provide surface applied protection prior to surface preparation and painting operations.
      c. Following completion of painting in each space or area, reinstall the removed items by using workmen who are skilled in the necessary trades.
2. Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall onto wet newly painted surfaces.

C. Preparation of Wood Surfaces
   1. Clean wood surfaces until free from dirt, oil, and other foreign substance.
   2. Smooth finished wood surfaces exposed to view, using the proper sandpaper. Where so required, use varying degrees of coarseness in sandpaper to produce a uniformly smooth and unmarred wood surface.
   3. Unless specifically approved by the Architect, do not proceed with painting of wood surfaces until the moisture content of the wood is 12 percent or less as measured by a moisture meter approved by the Architect.

D. Preparation of Metal Surfaces
   1. Thoroughly clean surfaces until free from dirt, oil and grease.
   2. On galvanized surfaces, use solvent for the initial cleaning, and then treat the surface thoroughly with the phosphoric acid etch. Remove etching solution completely before proceeding.
   3. Allow to dry thoroughly before application of paint.

3.02 PAINT APPLICATION

A. General
   1. Touch-up shop-applied prime coats which have been damaged, and touch-up bare areas prior to start of finish coats application.
   2. Slightly vary the color of succeeding coats.
   3. Sand and dust between coats to remove defects visible to the unaided eye from a distance of 5 feet.
   4. On removable panels and hinged panels, paint the back sides to match the exposed sides.

B. Concrete and Unit Masonary Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of trisodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

C. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.

D. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

E. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

F. Drying: Allow sufficient drying time between coats, modifying the period as recommended by the material manufacturer to suite adverse weather conditions.

G. Brush Applications
   1. Brush out and work the brush coats onto the surface in an even film.
   2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness and other surface imperfections will not be acceptable.

H. Spray Application
   1. Confine spray application to metal framework and similar surfaces where hand brush work would be inferior.
   2. Where spray application is used, apply each coat to provide the hiding equivalent of brush coats.
3. Do not double back with spray equipment to build up film thickness of 2 coats in 1 pass.

I. Miscellaneous Surfaces and Procedures
1. Exposed mechanical items:
   a. Finish electric panels, access doors, conduits, pipes, ducts, grilles, registers, vents and items of similar nature to match the adjacent wall and ceiling surfaces, or as directed.
   b. Paint visible duct surfaces behind vents, registers, and grilles flat black.
   c. Wash metal with solvent, prime and apply 2 coats of alkyd enamel.
2. Exposed pipe and duct insulation:
   a. Apply 1 coat of latex paint on insulation which has been sized or primed under other Sections; apply 2 coats on such surfaces when unprepared.
   b. Match color of adjacent surfaces.
   c. Remove band before painting, and replace after painting.
3. Paint interior surfaces of air ducts and convectors and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
4. Paint dampers exposed behind louvers, grilles, and convectors and baseboard cabinets to match face panels.
5. Hardware:
   a. Paint prime coated hardware to match adjacent surfaces;
   b. Paint metal portions of head seals, jamb seals, and astragal seals to match the color of the door frame unless otherwise directed by the Architect.
6. Wet areas:
   a. For oil base paints, use 1 percent phenolic or 4 percent tetrachlorophenolic.
   b. For water emulsion and glue size surfaces, use 4 percent sodium tetrachlorophenolate.
7. Interior: Use "stipple" finish where enamel is specified.
8. Exposed Vents: Apply 2 coats of heat resistant paint approved by the Architect.

3.03 EXTERIOR PAINT SCHEDULE
A. Exterior Ferrous Metal and Galvanized Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items. Reprime all areas where primer has been scratched, scraped or removed.
   a. Ferrous and Galvanized Metal Primer
      1) Self-priming polyamide epoxy applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 3.0 to 5.0 mils.
      2) Product: Tnemec, “Series 66 Hi-Build Epoxoline”, or equal.
   b. First and Second Coats
      1) Semi-gloss, aliphatic acrylic polyurethane applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.0 to 5.0 mils per coat.
      2) Product: Tnemec, “Series 75 Endura-Shield”, or equal.
   c. Top Coat
      1) Clear, high gloss, aliphatic acrylic polyurethane applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.0 to 2.0 mils.

3.04 INTERIOR PAINT SCHEDULE
A. Gypsum Board
   1. Eggshell Finish: 2 finish coats over a primer at offices, studios, Classroom Corridor and at areas to matching existing.
      a. Primer
         1) Latex based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
         2) Product: ICI Dulux - 1080 Dulux Ultra, or equal.
      b. First and Second Coats
         1) Low luster eggshell, acrylic-latex based, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
         2) Product: ICI Dulux - 1403 Dulux Ultra, or equal.
   2. Semi-gloss Acrylic Enamel Finish: 2 finish coats over a primer at store rooms
      a. Primer
         1) Latex based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
         2) Product: ICI Dulux - 1080 Dulux Ultra, or equal.
      b. First and Second Coats
         1) Semi-gloss, acrylic latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.
         2) Product: ICI Dulux - 1407 Dulux Ultra, or equal.

B. Wood Designated to Receive Transparent Finish
   1. Clear Satin Finish: Provide number of coats and apply to wood in accordance with the manufacturer's instructions as follows:
      a. Stain Coat: Sherwin-Williams, "Wiping Stain S64 Series", or equal.
      d. Finish Coat: Sherwin-Williams, "Water White Conversion Varnish V84F82,MRE (34-38 units of Gloss)", reduced up to 3% with "Xylene, Catalyzer V66V25", catalyzed with "Sheer-Kenver Catalyzest V66V21" at 3%, or equal.

C. Ferrous Metal
   1. Semi-gloss, Acrylic Enamel Finish: 1 finish coat over enamel undercoat and a primer. Primer is not required on shop-primed items.
      a. Primer
         1) Quick drying, rust-inhibitive epoxy metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
         2) Product: ICI Dulux - 4160 Ultra-Hide, or equal.
      b. Undercoat
         1) Acrylic, interior enamel undercoat or semigloss, acrylic latex, interior enamel, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils.
         2) Product: ICI Dulux - 1120 Ultra-Hide, or equal.
      c. Finish Coat
         1) Semi-gloss, acrylic latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils.
         2) Product: ICI Dulux - 1407 Dulux Ultra, or equal.

D. Galvanized Metal
1. Semi-gloss, Acrylic Enamel Finish: 2 finish coats over a primer.
   a. Primer
      1) Galvanized metal primer applied at spreading rate recommended by the
         manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
      2) Product: ICI Dulux - 4020 Devflex, or equal.
   b. First and Second Coats
      1) Semi-gloss, acrylic latex interior enamel applied at spreading rate
         recommended by the manufacturer to achieve a total dry film thickness of not
         less than 2.6 mils.
      2) Product: ICI Dulux - 1407 Dulux Ultra, or equal.

3.06 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT
A. Paint shop-primed equipment, where indicated.
B. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical
   components and paint separately.
C. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings
   removed prior to finishing.
D. Paint exposed Mechanical ductwork and equipment, and electrical conduits prior to
   installation of new light fixtures.

3.07 SURFACES TO BE FINISHED
A. Do Not Paint or Finish the Following Items:
   1. Items fully factory-finished unless specifically noted.
   2. Fire rating labels, equipment serial number and capacity labels.
   3. Stainless steel items.
B. Paint both sides and edges of plywood backboards for electrical and telecommunications
   equipment before installing equipment.

3.08 CLEANING
A. Collect waste material which may constitute a fire hazard, place in closed metal containers,
   and remove daily from site.

END OF SECTION
SECTION 10 11 00

VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Markerboards, Interactive boards and Tackboards.

1.02 REFERENCE STANDARDS


1.03 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.
B. Product Data: Provide manufacturer’s data on markerboard, tackboard, trim, and accessories.
C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
D. Samples: Submit color charts for selection of color and texture of markerboard, tackboard, and trim.
E. Manufacturer’s printed installation instructions.
F. Maintenance Data: Include data on regular cleaning, stain removal.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.

1.05 WARRANTY

A. See Section 01 77 00 - Contract Closeout Procedures for additional warranty requirements.
B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Markerboards:
   1. Basis of Design: Model 1300 Series LCS-II by Claridge Products or approved equal.
   4. Substitutions: See Section 01625 - Product Options and Substitutions.

B. Interactive boards:
   1. Basis of Design: Balt $ Best-Rite, a brand division of Moore Co.mult-purpose audio.visual board or approved equal
2.02 VISUAL DISPLAY BOARDS

A. Markerboards: Porcelain enamel on steel, laminated to core.
   2. Metal Face Sheet Thickness: 0.024 inch (24 gage).
   3. Enameling grade steel shall be coated with a three coat process as follows:
      a. Bottom Ground Coat - 1.5 to 2.2 mils.
      b. Top Ground Coat - 2.0 - 2.8 mils.
      c. Top Cover (Color) Coat - 3.0 to 4.0 mils.
   4. Core: Density Fiberboard (MDF, 7/16 inch thick, laminated to face sheet.
   5. Backing: Aluminum sheet, laminated to core.
   6. Size: As indicated on drawings.
   7. Frame: Extruded aluminum, with concealed fasteners.
  10. Accessories: Provide chalk tray and map rail.
  11. Basis of Design: Model 1300 Series LCS-II.

B. Interactive boards:
   1. Moore Co. "projection Plus" boards with deluxe aluminum trim, audio/visual boards serving
      as markerboard and projection surface, color white.
   2. Porcelain steel surface: Matte grey, magnetic, balanced porcelain enamel ground coat
      furnace-fused to both sides of 28-gage steel, with color fusion ceramic top coat
      a. Core:MDF
   3. Trim: 0.88 inch profile anodized aluminum with hairline mitered corners.
   4. Accessories: Provide chalk tray, full-length and map rail.

B. Tackboards: Fine-grained, homogeneous natural cork.
   1. Basis of Design: Model 900A.
   3. Backing: Hardboard, 1/4 inch thick, laminated to tack surface.
   4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke
      developed index of 450, maximum, when tested in accordance with ASTM E84.
   5. Size: As indicated on drawings.
   6. Frame: Same type and finish as for markerboard.
   7. Frame Profile: Type "CO" with snap-on aluminum trim #273B and surface applied
      continuous ground #77; and clips #277W.

2.03 MATERIALS

A. Porcelain Enamed Steel Sheet: ASTM A424, Type I, Commercial Steel, with fired-on vitreous
   finish.

B. Hardboard for Chalk Surface: AHA A135.4, Tempered type.

C. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.

D. Aluminum Sheet Backing: 0.015 inch thick.

E. Adhesives: Type used by manufacturer.
2.04 ACCESSORIES

A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall, full width of frame.

B. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.

C. Chalk Tray: Aluminum, manufacturer's standard profile one piece full length of chalkboard, molded ends; concealed fasteners, same finish as frame.

D. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.

B. Secure units level and plumb.

C. Carefully cut holes in boards for thermostats, wall switches, and fire alarms.

3.03 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.

B. Cover with protective cover, taped to frame.

C. Remove temporary protective cover at date of Substantial Completion.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Room and door signs.
B. Building identification signs.
C. Code Compliance Signs: Signs shall be inspected per CBC 11B-703.1.1.2.
D. Emergency Evacuation Maps.

1.02 REFERENCE STANDARDS

C. CBC - California Building Code, 2010, latest edition with amendments. Signage shall comply with Sections 11B - Division 7, 1011 and 1022.8. All accessibility signage shall comply with the requirements in CBC Chapter 10 and 11B.

1.03 DEFINITIONS

A. Braille Symbols: California Contracted Grade 2 Braille shall be used wherever Braille symbols are specifically required in other portions of these standards. Dots shall be 1/10-inch on centers in each cell with 3/10-inch space between cells. Dots shall be raised a minimum of 1/40-inch above the background.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.
B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, Braille data, foreground and background colors, locations, overall dimensions of each sign.
C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
   1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
   2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
   3. Submit for approval by Owner through Architect prior to fabrication.
D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, Braille and method of attachment.
E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
F. Verification Samples: Submit samples showing colors specified.
G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Source Limitations: Obtain each size type color pattern and variety of regulatory sign used for the Project through one source from the same manufacturer.

C. Comply with applicable provisions in ADA-ABA Accessibility Guidelines, CBC Chapter 11B, Section 11B.5.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flat Signs:
   5. Substitutions: See Section 01 60 00 - Product Requirements and Substitutions.

B. Dimensional Letter Signs:
   1. Aluminum Cast letters by Metal Arts; www.metalarts.net
   2. Aluminum Cast letters by Signletters.com; www.signletters.com
   3. Substitutions: See Section 01 60 00 - Product Requirements and Substitutions.

2.02 SIGNAGE REQUIREMENTS

A. Code compliance signs include: International Symbol of Accessibility signs (ISA) at building entrances; Assistive Listening System signs (ALS), California Restroom symbols on doors and restroom identification sign on walls; Stair and Elevator Identification signs; details as shown on Drawings.

B. Code Compliance Signs include the following signs:
   1. Restroom Doors
   2. Room Identification Signage
   3. Tactile Exit and Exit Route Signage
   4. Assistive Listening Signage

2.03 SIGNAGE APPLICATIONS

A. Accessibility Compliance: In addition to CBC, signs are required to comply with ADAAG and ANSI/ICC A 117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. All Signage Types: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.
   3. Background Color: Contrast between character, symbols and their background must be 70% minimum and have a non-glare finish. CBC Section 11B-703.5.1.
C. Room Identification and Tactile Exit Signs: Provide a sign for every doorway, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with engraved panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Contracted California (Grade 2) Braille.
   3. Braille shall be rounded or contracted domed top.
   4. Character Height: As indicated on drawings.
   5. Sign Height: As indicated on drawings.
   6. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings.
   7. Conference and Meeting Rooms: Assistive Listening Signage, and identify with room numbers to be determined later, not the numbers shown on the drawings.
   8. Service Rooms: Identify with the room names and numbers shown on the drawings.
   9. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", and Contracted California (Grade 2) Braille.
   10. Inserts: Provide 3 interchangeable inserts where indicated on sign type. Black coatings on white background. Size and thickness as indicated on drawings.

D. Building Identification Signs:
   1. Letter style, size, attachment and finish shall be as detailed on drawings.
   2. Individual metal letters shall be mounted to flat metal plate. Plate shall be anchored to building component as shown on Drawings
   3. Mount signs in locations as shown on Drawings.

2.04 MATERIALS

A. Cast plastic sheet: Cast (not extruded or continuous cast) methacrylate acrylic sheet with a minimum flexural strength of 16,000 psi, complying with ASTM D 790, as follows.
   1. Transparent sheet: Colorless sheet with light transmittance of 92 percent, ASTM D 1003, in matte finish, unless otherwise indicated.
   2. Translucent sheet: White or colored translucent sheet of density required to produce uniform brightness and free of blistering, fading and other imperfections.
   3. Opaque sheet: Colored opaque acrylic sheet in colors and finishes indicated.

B. Colored coatings for acrylic sheet: Non-fading coatings, including inks and paints for copy and background colors, recommended by acrylic manufacturers for optimum adherence to acrylic surface where applicable.

C. Adhesive: Transparent silicone glue by Dow Corning or GE. Use in conjunction with 2-sided Polyfoam tape or Isotac contact adhesive by 3M, in minimum thickness available.
   1. Completely cover the plate with adhesive.

D. Fasteners: Concealed fasteners unless otherwise indicated. Fabricate from metals that are non-corrosive to sign materials and mounting surface.

2.05 ACRYLIC SIGNS

A. Surface and subsurface silkscreened acrylic signs:
   1. Silkscreen copy shall be photo-produced using fine mesh screens, 280 mesh or finer, and screening inks.
   2. Surface of printed material shall be uniform in color and finish and free of pinholes or other blemishes.
   3. Signs shall be consistent in color, value and coverage, and shall maintain proper opacity, or translucency as applicable, and shall be free of blistering, fading and other imperfections.
   4. Sign color registration shall be crisp, sharp and free of imperfections.
   5. Pictogram color shall match character color.

SIGNAGE
10 14 00-3
2.06 TYPICAL SIGNAGE

A. Flat Signs: Signage media without frame.
   1. Edges: Square.
   2. Corners: Radiused.
   3. Wall Mounting of One-Sided Signs: double-sided tape adhesive and silicone glue per 2.04 C.
   4. Signs shall have letters and graphics silk-screened on reverse side of acrylic surface.

B. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.
   3. Background Color: White, per campus standard color.
   4. Character Color: Black, per campus standard colors.

2.07 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored acrylic; engraved through face to expose core as background color:
   1. Total Thickness: 1/4 inch.

B. Pictogram: See paragraph 2.05 for typical signage specifications.

2.08 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
   2. Interior: Bright finish.

B. Fasteners: Concealed fasteners unless otherwise indicated. Fabricate from metals that are non-corrosive to sign materials and mounting surface.

C. Where flat signs are mounted on glass walls:
   1. Provide an additional blank plate with same background color.
   2. Mount this plate on the inside of glass in alignment with sign plate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Signage mounting: Glue and mechanically attach signs to substrates.

B. Install in accordance with approved shop drawings, manufacturer's instructions.

C. Install neatly, with horizontal edges level.

D. Locate signs where indicated:
   1. Room and Door Signs: Locate on wall at latch side of door as indicated on drawings.
   2. If no location is indicated obtain Owner's instructions.

E. Protect from damage until Substantial Completion; repair or replace damage items.
END OF SECTION
SECTION 10 21 13

TOILET PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Phenolic toilet compartments.

B. Urinal screens.

1.02 REFERENCE STANDARDS

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls.

1.04 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures, for submittal procedures.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

C. Product Data: Provide data on panel construction, hardware, and accessories.

D. Samples: Submit two samples of partition panels, 12 by 12 inch in size illustrating panel finish, color, and sheen.

E. Manufacturer’s Installation Instructions: Indicate special procedures.

1.05 WARRANTY

A. See Section 01 77 10 - Contract Closeout Procedures for additional warranty requirements.

B. Furnish fifteen-year limited warranty panels, doors, and styles against breakage, corrosion, delamination, and defects in factory workmanship.

C. Furnish one-year warranty against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Phenolic Toilet Compartments:
   2. Substitutions: Not permitted.

2.02 COMPONENTS

A. Solid phenolic material constructed of solidly fused plastic laminate with matte-finished melamine surfaces, colored face sheets, and black phenolic-resin core that are integrally bonded. Edges shall be black. Brown edges are not acceptable. Color and pattern as selected by Architect for Bobrick’s standard colors.

B. Solid phenolic material shall meet National Fire Protection Association and International Building Code Interior Wall and Ceiling Finish Class 1, when tested in accordance with ASTM E-84 Fire Resistance Standards: flame spread 69, smoke density 93.

C. Door and Panel Dimensions:
2. Style Thickness: 3/4 inch.
3. Panel Thickness: 1/2 inch.
4. Door Width: 24 inch.
5. Door Width for Handicapped Use: 36 inch, out-swinging.
6. Height: 58 inch.
7. Thickness of Pilasters: 1 inch.

D. Urinal Screens: Wall mounted with two panel brackets, and floor-to-ceiling vertical upright consisting of pilaster anchored to floor and ceiling.

E. Color: S0-04 Mid Grey

2.03 ACCESSORIES

A. Pilaster Shoes: Formed chromed steel with polished finish, 4 in high, concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Hollow anodized aluminum tube, 1 x 1-5/8 inch size, with anti-grip strips and cast socket wall brackets.

C. Pilaster Brackets: Polished stainless steel.

D. Wall Brackets: Continuous type, polished stainless steel.

E. Hardware: Provide vandal-resistant stainless steel Institutional Hardware, for each compartment to comply with ADA for accessibility and as follows:
   1. Continuous piano hinge, self-closing, adjustable for door close positioning.
   2. Door Latch: Slide type with exterior emergency access feature.
   3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
   4. Coat hook with rubber bumper; one per compartment, mounted on door.
      a. Mount at +48 inches above finished floor.
   5. Provide U-pulls handles on both sides of stall doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.
3.03 TOLERANCES
A. Maximum Variation from True Position: 1/4 inch.
B. Maximum Variation from Plumb: 1/8 inch.

3.04 ADJUSTING
A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
C. Adjust adjacent components for consistency of line or plane.

END OF SECTION
SECTION 10 28 13

TOILET ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Accessories for toilet rooms.
B. Grab bars.
C. Owner furnished, Contractor installed accessories.

1.02 REFERENCE STANDARDS

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2010.
C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.04 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures, for submittal procedures.
B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.
C. Manufacturer’s Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products listed are made by Bobrick.
B. Other Acceptable Manufacturers:
   3. Substitutions: See Section 01 60 00 - Product Requirements and Substitutions.
C. All items of each type to be made by the same manufacturer.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
B. Keys: Provide 4 keys for each accessory to Owner; master key all lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269, Type 304 or 316.


F. Mirror Glass: Float glass, ASTM C 1036 Type I, Class 1, Quality Q2, with silvering, copper coating, and suitable protective organic coating to copper backing in accordance with GSA CID A-A-3002.

G. Adhesive: Two component epoxy type, waterproof.

H. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, security type.

I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.

B. Back paint components where contact is made with building finishes to prevent electrolysis.

2.04 TOILET ROOM ACCESSORIES

A. Item numbers listed below correspond to Toilet Accessory Keynotes on Architectural Sheet A7.1.
   1. Item numbers not shown are not included in this section.

B. Item 1. Grab Bars: Stainless steel, 1-1/4 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
   1. Length and configuration: As indicated on drawings.

C. Item 2. Mirrors: Stainless steel framed, 6 mm thick float glass mirror.
   1. Size: 24 x 36.
   2. Product: B-165 2436 manufactured by Bobrick.

D. Item 3: Toilet Partitions, see Section 10170.

   1. Product: KB110-SSRE manufactured by Koala Kare.

F. Item 5: Underlavatory guards (Unisex Restroom).

   1. Product B-212 manufactured by Bobrick.

H. Item 7: Fold-Down Shelf at back of each stall door.
   1. Product B-287 manufactured by Bobrick.

   1. Product: B-4388 manufactured by Bobrick.

1. Product: B-3094 manufactured by Bobrick.

   1. Product: B-3471 manufactured by Bobrick.

   1. Product: B-3571 manufactured by Bobrick.

   1. Door: Seamless 0.05 inch door with returned edges and tumbler lock.
   2. Cabinet: Fully welded, 0.03 inch thick sheet.
   3. Operation: 25 cent coin required to operate dispenser. Provide locked coin box, separately keyed.
   4. Identify dispenser slots without using brand names.
   5. Minimum capacity: 20 napkins and 30 tampons.


P. Item 15. Paper Towel Dispenser, roll towels, surface-mounted, Owner-furnished, Contractor-installed.

Q. Item 16. Liquid Soap Dispenser, surface-mounted, Owner-furnished, Contractor-installed.


   1. Product: B-36903 manufactured by Bobrick.

   1. Product: B-224 manufactured by Bobrick.

V. Item 21. Under Sink Insulator Protectors at ADA sinks.
   1. "Trap Gear" Soft PVC Sleek Fit by Plumberex.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify exact location of accessories for installation.
   C. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION
   A. Deliver inserts and rough-in frames to site for timely installation.
   B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION
   A. Install accessories in accordance with manufacturers’ instructions.
B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights and Locations: As required by accessibility regulations, as indicated on drawings, and as follows:

END OF SECTION
SECTION 10 44 00

FIRE EXTINGUISHERS, CABINETS AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.
B. Fire extinguisher cabinets, fire-rated and non-fire-rated.
C. Accessories.

1.02 REFERENCE STANDARDS

A. State of California Code of Regulations (CCR) Title 19, State Fire Marshal (SFM) - Public Safety Regulations

1.03 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.
B. Shop Drawings: Indicate cabinet physical dimensions.
C. Product Data:
   1. Provide extinguisher operational features, color and finish, rated capacity and physical dimensions.
   2. Cabinet: Physical and rough-in dimensions, fire-rating if required, color and materials.
D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguisher Cabinets and Accessories:
   4. Substitutions: See Section 01 60 00 - Product Requirements and Substitutions.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of (CCR) Title 19 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by Underwriters Laboratories Inc. for the purpose specified and indicated, with current certification tags attached.
B. Dry Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gage.
   1. Class: A:B:C.
   2. Size: 10 pound, 4A:80B:C.
   3. Finish: Baked polyester powder coat, red color.

2.03 FIRE EXTINGUISHER CABINETS

A. Metal: Formed primed steel sheet; 0.036 inch thick base metal.
B. Box construction: cold-rolled steel with baked enamel finish
   1. Where cabinet occurs in fire-rated wall, provide the following:
      2. Fire-rated cabinet with Larsen's Flame-shield Option, or equal, certified by Warnock
         Hersey for one hour combustible and non-combustible wall systems to meet the
         requirements of UBC Standard 7-5 (ASTM E814-83). All fire-rated cabinets to have trims
         with reinforced corners and factory supplied anchoring devices.

C. Door Glazing: Glass, clear, 1/8 inch thick float tempered safety glass. Set in resilient channel
   gasket glazing.

D. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.

E. Weld, fill, and grind components smooth.

F. Provide Break-away lock for emergency access to fire extinguisher.

G. Finish of Cabinet Exterior Trim and Door: Steel with standard white baked acrylic enamel finish.

H. Finish of Cabinet Interior: White enamel.

I. Cabinet Configuration, Type 1: Semi-recessed type, model #SS 2712-RL.
   1. Sized to accommodate accessories.
   2. Where rated cabinet is required: model #FS SS 2712-RL.
   3. Exterior nominal dimensions of 12 inch wide x 27 inch high x 8 inch deep.
   4. Trim: Returned to wall surface, with 3-1/2 inch projection, 1-3/8 inch wide face.

J. Cabinet Configuration Type 2: Recessed type, model #SS 2712-R.
   1. Sized to accommodate accessories.
   2. Where rated cabinet is required: model #FS SS 2712-R.
   3. Exterior nominal dimensions of 9 inch wide x 24 inch high x 5-3/4 inch deep.

2.04 ACCESSORIES
   A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION
   A. Install in accordance with manufacturer’s instructions.
   B. Install cabinets plumb and level in wall openings at locations shown on drawings.
   C. Secure rigidly in place.
   D. Where cabinets occur in fire-rated wall assemblies, install type X gypsum board behind cabinet
      as shown in drawings to meet building inspector’s approval.
   E. Where cabinets occur in sound-rated wall assemblies, see Drawings for details.
   F. Place extinguishers in cabinets at time of Certificate of Occupancy.
   G. Extinguishers must have current certification tags attached

FIRE EXTINGUISHERS, CABINETS AND ACCESSORIES
10 44 00-2
H. Place extinguishers and accessories in cabinets at time of Substantial Completion.

END OF SECTION
SECTION 22 00 50

BASIC PLUMBING MATERIALS AND METHODS

PART 1  GENERAL

1.1 SECTION INCLUDES

A.  Valves and fittings.
B.  Access Doors.
C.  Expansion loops.
D.  Insulation.

1.2 RELATED DOCUMENTS

A.  Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B.  This Section is a part of each Division 22 Section.

1.3 ADDITIONAL REQUIREMENTS

A.  Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.
B.  Make all temporary connections required to maintain services during the course of this Contract without additional cost to the Owner. Notify the Owner seven days in advance before disturbing any service.

1.4 REFERENCED STANDARDS

A.  Where material or equipment is specified to conform to referenced standards, it shall be assumed that the most recent edition of the standard in effect at the time of bid shall be used.
1.  CSA – Canadian Standards Association International
2.  ANSI - American National Standards Institute
3.  ASTM - American Society for Testing and Materials
4.  CCR - California Code of Regulations
   a.  Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36
5.  NCPWB - National Certified Pipe Welding Bureau
6.  CEC - California Electrical Code
7.  NEMA - National Electrical Manufacturers' Association
8.  NFPA - National Fire Protection Association
9.  OSHA - Occupational Safety and Health Act
10.  UL - Underwriters' Laboratories, Inc.

1.5 DRAWINGS
A. Examine Contract Documents prior to bidding of work and report discrepancies in writing to Architect.

B. Contractor shall visit Project site and examine existing conditions in order to become familiar with Project scope. Verify dimensions shown on Drawings at Project site. Bring discrepancies to the attention of Architect. Failure to examine Project site shall not constitute basis for claims for additional work because of lack of knowledge or location of hidden conditions that affect Project scope.

C. Drawings showing location of equipment and materials are diagrammatic and job conditions will not always permit installation in location shown. The Plumbing Drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as existing conditions, actual building construction, and work of other trades permit.
   1. Architectural and Structural Drawings shall be considered part of the Work. These Drawings furnish Contractor with information relating to design and construction of the Project. Architectural Drawings take precedence over Plumbing Drawings.
   2. Because of the small scale of Plumbing Drawings, not all offsets, fittings, and accessories required are shown. Investigate structural and finish conditions affecting the Work and arrange Work accordingly. Provide offsets, fittings, and accessories required to meet conditions. Inform Architect immediately when job conditions do not permit installation of equipment and materials in the locations shown. Obtain the Architects approval prior to relocation of equipment and materials.
   3. Relocate equipment and materials installed without prior approval of the Architect. Remove and relocate equipment and materials at Contactors’ expense upon Architects’ direction.
   4. Minor changes in locations of equipment, piping, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.

D. Execute work mentioned in Specifications and not shown on Drawings, or vice versa, the same as if specifically mentioned or shown in both.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. The publications listed below form part of this specification; comply with provisions of these publications except as otherwise shown or specified.
   2. California Electrical Code, 2013
   8. California Code of Regulations, Title 24
   10. CAL-OSHA
   11. California State Fire Marshal, Title 19 CCR
   12. National Fire Protection Association
   13. Occupational Safety and Health Administration
   14. Other applicable state laws

B. Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes, or to requirements of authorities having jurisdiction. It is not the intent of Drawings or specifications to repeat requirements of codes except where necessary for clarity.

D. When Contract Documents differ from governing codes, furnish and install larger size or higher standards called for without extra charge.

E. No material installed as part of this Work shall contain asbestos.

1.7 FEES AND PERMITS

A. Obtain and pay for all permits and service required in installation of this work; arrange for required inspections and secure approvals from authorities having jurisdiction. Comply with requirements of Division 01.

B. Arrange for utility connections and pay charges incurred, including excess service charges.

1.8 UTILITY CONNECTIONS

A. Bear the cost of construction related to utility services, from point of connection to utility services shown on Contract Documents. This includes piping, excavation, backfill, meters, boxes, check valves, backflow prevention devices, general service valves, concrete work, and the like, whether or not Work is performed by Contractor, local water/sanitation district, public utility, other governmental agencies or agencies' assigns.

1.9 FRAMING, CUTTING AND PATCHING

A. Special framing, recesses, chases and backing for Work of this Section, unless otherwise specified, are covered under other Specification Sections.

B. Contractor is responsible for placement of pipe sleeves, hangers, inserts, supports, and location of openings for the Work.

C. Cutting, patching, and repairing of existing construction to permit installation of equipment, and materials is the responsibility of Contractor. Repair or replace damage to existing work with skilled mechanics for each trade.

D. Cut existing concrete construction with a concrete saw. Do not utilize pneumatic devices.

E. Core openings through existing construction for passage of new piping and conduits. Cut holes of minimum diameter to suit size of pipe and associated insulation installed. Coordinate with building structure, and obtain Structural Engineer's approval prior to coring through existing construction.

1.10 SUBMITTALS

A. Submittal packages may be submitted via email as PDF electronic files, or as printed packages. PDFs shall be legible at actual size (100 percent). Provide seven copies of printed submittal packages.

B. Provide submittal of materials proposed for use as part of this Project. Product names in Specifications and on Drawings are used as standards of quality. Furnish standard items on specified equipment at no extra cost to the Contract regardless of disposition of submittal data. Other materials or methods shall not be used unless approved in writing by Architect. Architect's review will be required even though "or equal" or synonymous terms are used. Refer to Division 01 for complete instructions.

BASIC PLUMBING MATERIALS AND METHODS
22 00 50-3
1. Partial or incomplete submittals will not be considered.
2. Quantities are Contractor's responsibility and will not be reviewed.
3. Provide materials of the same brand or manufacturer for each class of equipment or material.
4. Identify each item by manufacturer, brand, trade name, number, size, rating, or other data necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.
5. Identify each submittal item by reference to items' Specification Section number and paragraph, by Drawing and detail number, and by unit tag number.
6. Organize submittals in same sequence as in Specification Sections.
7. Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, and weight.
   a. Submit Shop Drawings, performance curves, and other pertinent data, showing size and capacity of proposed materials.
   b. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of Contract Documents.
   c. Drawings shall be drawn to scale and dimensioned (except schematic diagrams). Drawings may be prepared by vendor but must be submitted as instruments of Contractor, thoroughly checked and signed by Contractor before submission to Architect for review.
   d. Catalog cuts and published material may be included with supplemental scaled drawings.

C. Review of submittals will be only for general conformance with design concept and general compliance with information given in Contract Documents. Review will not include quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with work of other trades, or construction safety precautions, which are sole responsibility of Contractor. Review of a component of an assembly does not indicate acceptance of an assembly. Deviations from Contract Documents not clearly identified by Contractor are Contractor's responsibility and will not be reviewed by Architect.

D. Within reasonable time after award of contract and in ample time to avoid delay of construction, submit to Architect Shop Drawings or submittals on all items of equipment and materials provided. Provide submittal in at least seven copies and in complete package.
   1. Shop Drawings and submittals shall include Specification Section, Paragraph number, and Drawing unit symbol or detail number for reference. Organize submittals into booklets for each Specification section and submit in loose-leaf binders with index. Deviations from the Contract Documents shall be prominently displayed in the front of the submittal package and referenced to the applicable Contract requirement.

E. Furnish to the Project Inspector complete installation instructions on material and equipment before starting installation.

F. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.

G. Provide product data for insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings, indicating compliance with requirement that these products contain less than 0.1 percent (by mass) polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations.
H. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of the California Health and Safety Code Section 11 68 75. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.

I. Delegated-Design Submittal: For seismic supports, anchorages, and restraints indicated to comply with performance requirements and design criteria.
2. Supports, anchorage and restraints for piping, ductwork, and equipment shall be an OSHPD pre-approved system such as Tolco, Afcon, ISAT, Badger, Mason, or equal. Pipes, ducts and equipment shall be seismically restrained in accordance with requirements of current edition of California Building Code. System shall have current OPM number and shall meet additional requirements of authority having jurisdiction. Provide supporting documentation required by the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping, ductwork and restraint locations.
   a. Bracing of Piping and Equipment: Specifically state how bracing attachment to structure is accomplished. Provide shop drawings indicating seismic restraints, including details of anchorage to building. In-line equipment must be braced independently of piping, and in conformance with applicable building codes. Provide calculations to show that pre-approval numbers have been correctly applied in accordance with general information notes of pre-approval documentation.
3. In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, ductwork, and restraint locations, and detail supports, attachments and restraints, and furnish supporting calculations and legible details sealed by a California registered structural engineer, in accordance with 2013 California Building Code.
4. Additional Requirements: In addition to the above, conform to all state and local requirements.

1.11 SUBSTITUTIONS

A. Refer to Division 01 for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In the case of conflict between requirements given herein and those of Division 01, Division 01 requirements shall apply.

B. It is the responsibility of Contractor to assume costs incurred because of additional work and or changes required to incorporate proposed substitute into the Project. Refer to Division 01 for complete instructions.

C. Substitutions will be interpreted to be all manufacturers other than those specifically listed in the Contract Documents by brand name, model or catalog number.

D. Only one request for substitution will be considered for each item of equipment or material.

E. Substitution requests shall include the following:
   1. Reason for substitution request.
   2. Complete submittal information as described herein; see "Submittals."
   3. Coordinated scale layout drawings depicting position of substituted equipment in relation to other work, with required clearances for operation, maintenance and replacement.
   4. List optional features required for substituted equipment to meet functional requirements of the system as indicated in Contract Documents.
   5. Explanation of impact on connected utilities.
   6. Explanation of impact on structural supports.
F. Installation of reviewed substitution is the Contractors’ responsibility. Any mechanical, electrical, structural, or other changes required for installation of reviewed substituted equipment or material must be made by the Contractor without additional cost to the Owner. Review by the Architect of the substituted equipment or material, including dimensioned Drawings will not waive these requirements.

G. Contractor may be required to compensate the Architect for costs related to substituted equipment or material.

1.12 OPERATION AND MAINTENANCE MANUAL

A. Furnish three complete sets of Operation and Maintenance Manual bound in hardboard binder, and one compact disc containing complete Operation and Maintenance Manual in searchable PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in binder and disc. Start compiling data upon approval of submittals.
   1. Sets shall incorporate the following:
      a. Service telephone number, address and contact person for each category of equipment or system.
      b. Complete operating instructions for each item of plumbing equipment.
      c. Copies of guarantees/warrantees for each item of equipment or systems.
      d. Test data and system balancing reports.
      e. Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
      f. Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
      g. Control diagrams and literature.
      h. A complete list or schedule of all scheduled valves giving the number of the valve, location and the rooms or area controlled by the valve. Identify each valve with a permanently attached metal tag stamped with number to match schedule. Post list in frame under plastic on wall in mechanical room or where directed by Architect.
      i. Check test and start reports for each piece of plumbing equipment provided as part of the Work.
      j. Commissioning and Preliminary Operation Tests required as part of the Work.

B. Post service telephone numbers and/or addresses in an appropriate place as designated by the Architect.

1.13 SITE CONDITIONS

A. Information on Drawings relative to existing conditions is approximate. Deviations from Drawings necessary during progress of construction to conform to actual conditions shall be approved by the Architect and shall be made without additional cost to the Owner. The Contractor shall be held responsible for damage caused to existing services. Promptly notify the Architect if services are found which are not shown on Drawings.

1.14 EXISTING MATERIALS

A. Remove existing equipment, piping, wiring, construction, etc., which interferes with Work of this Contract. Promptly return to service upon completion of work in the area. Replace items damaged by Contractor with new material to match existing.

B. Removed materials which will not be re-installed and which are not claimed by Owner shall become property of Contractor and shall be removed from Project site. Consult Owner before
removing any material from Project site. Carefully remove materials claimed by Owner to prevent damage and deliver to Owner-designated storage location.

C. Existing piping and wiring not reused and are concealed in building construction may be abandoned in place and all ends shall be capped or plugged. Remove unused piping and wiring exposed in Equipment Rooms or occupied spaces. Material shall be removed from Project premises. Disconnect power, water, gas, pump or any other active energy source from piping or electrical service prior to abandoning in place.

D. Existing piping, ductwork, and equipment modified or altered as part of this Work shall comply with the most recent applicable code requirements.

1.15 WARRANTY

A. Refer to Division 01 for warranty requirements, including effective date of warranty. Refer to specific items of equipment specified herein for warranty duration if different from that specified in Division 01.

B. Repair or replace defective work, material, or part that appears within the warranty period, including damage caused by leaks.

C. On failure to comply with the above warranty within a reasonable length of time after notification is given, the Architect/Owner shall have the repairs made at the Contractor's expense.

1.16 RECORD DRAWINGS

A. Refer to Division 01, Record Documents, for requirements governing Work specified herein.

B. Upon completion of the work, deliver to Architect the following:
   1. Originals of drawings showing the Work exactly as installed.
   2. One complete set of reproducible drawings showing the Work exactly as installed.
   3. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.

C. Provide Contractor's signature, verifying accuracy of record drawings.

D. Obtain the signature of the Project Inspector for all record drawings.

1.17 DELIVERY AND STORAGE

A. Protect equipment and piping delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

1.18 COORDINATION

A. General:
   1. Coordinate Work in this Section with trades covered in other Specifications Sections to provide a complete, operable and sanitary installation of the highest quality workmanship.

B. Electrical Coordination:
   1. Refer to the Electrical Drawings and Specifications, Division 26, for service voltage and power feed wiring for equipment specified under this section. Contractor has full responsibility for the following items of work:
a. Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.  
b. If additional electrical services are required above that indicated on Electrical Drawings and in Division 26, such as more control interlock conductors, larger feeder, or separate 120 volt control power source, include cost to furnish and install additional electrical services as part of the bid.  
c. Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.

C. Mechanical Coordination:
   1. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
   3. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section “Access Doors and Frames.”

PART 2 PRODUCTS

2.1 GENERAL

A. Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.

B. All sizes, capacities, and efficiency ratings shown are minimum, except that gas capacity is maximum available.

C. Refer to Sections 22 10 00 and 23 80 00 for specific system piping materials.

2.2 VALVES AND FITTINGS FOR POTABLE WATER SYSTEMS

A. General:
   1. Provide valves and fittings conforming to lead-free requirements of California Health and Safety Code Section 11 68 75.
      a. Provide valves listed to NSF/ANSI 61-G or NSF/ANSI 372 for valve materials for potable-water service.
         1) Exception: Main distribution gate valves above 1-1/2 inches located underground outside building are not required to conform lead-free requirements of California Health and Safety Code Section 11 68 75.

B. Gate Valves:
   1. Los Medanos College requirement: Gate valves are not acceptable for use on this project.

C. Ball Valves:
   1. 2 inches and smaller: 600 psi CWP, cast bronze or brass body, full port, two piece, threaded ends, and reinforced PTFE seal, conforming to MSS SP-110. Nibco T-685-80-LF, Milwaukee UPBA400, Apollo 77C-LF10, Kitz 868, or equal.
   2. 2-1/2 inches: Apollo 77C-LF10, or equal.

2.3 JOINING MATERIALS

A. Refer to Division 22 and 23 piping sections for special joining materials not listed below.
B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated
      a. Full-Face Type: For flat-face, Class 125, cast iron and cast bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast iron and steel flanges.
   2. AWWA C111, rubber, flat face, 1/8-inch (3.2mm) thick, unless otherwise indicated; and full-face or ring type, unless other indicated.
   3. Flange Bolts and Nuts: AWWA C111, carbon steel, unless otherwise indicated.
   4. Plastic, Pipe-Flange Gasket, Bolts and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, 100 percent lead free alloys. Include water-flushable flux according to ASTM B813.

D. Brazing Filler Metals: AWS A5.8, BCup-5 Series, copper-phosphorus unless otherwise indicated. Sil-Fos 15, or equal.

2.4 ACCESS DOORS

A. Where floors, walls, or ceilings must be penetrated for access to mechanical equipment, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.
   1. All access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.

B. Access doors shall match those supplied in Division 08 in all respects, except as noted herein.

C. Provide stainless steel access doors for use in toilet rooms, shower rooms, kitchens and other damp areas. Provide steel access doors with prime coat of baked-on paint for all other areas.

D. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with the Architect when access is required in these areas.

E. Where specific information or details relating to access panels different from the above is shown or given on the Drawings or other Divisions of work, then that information shall supersede this specification.

F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products which may be incorporated into the Work include Milcor, Karp, Nystrom, or Cesco, equal to the following:
   1. Milcor
      a. Style K (plaster)
      b. Style DW (gypsum board)
      c. Style M (Masonry)
      d. Style "Fire Rated" where required

2.5 EXPANSION LOOPS

A. Manufactured assembly consisting of inlet and outlet elbow fittings, two sections of flexible metal hose and braid, and 180-degree return bend or center section of flexible hose. Flexible hose shall consist of corrugated metal inner hose and braided outer sheath.
B. Where used in potable water systems, provide expansion loops of all stainless steel construction.

C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

   Unisource Manufacturing, Inc., V series.

2.6 PIPE GUIDES

A. Where flexible connections are indicated on Drawings, provide Metraflex style IV, B-Line, or equal, pipe guides in locations recommended by manufacturer. Maximum spacing from flexible connection to first pipe guide is 4 pipe diameters, and maximum spacing from second pipe guide is 14 pipe diameters.

2.7 PIPE IDENTIFICATION

A. Identify each piping system and indicate the direction of flow by means of Seton, Inc., Marking Services Inc., Reef Industries, Inc., or equal, pre-tensioned, coiled semi-rigid plastic pipe labels formed to circumference of pipe, requiring no fasteners or adhesive for attachment to pipe.

B. The legends and flow arrows shall conform to ASME A13.1.

2.8 INSULATION WORK

A. General:
   1. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
   2. Adhesives and sealants shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
   3. The term "piping" used herein includes pipe, valves, strainers and fittings.
   4. Apply insulating cement to fittings, valves and strainers and trowel smooth to the thickness of adjacent covering. Cover with jacket to match piping. Extend covering on valves up to the bonnet. Leave strainer cleanout plugs accessible.
   5. Provide pre-formed PVC valve and fitting covers.
   6. Provide Calcium Silicate rigid insulation and sheet metal sleeve, 18 inch minimum length at each pipe hanger. Seal ends of insulation to make vapor tight with jacket.
   7. Urethane insulation will not be allowed above ground or on hot water piping.
   8. Test insulation, jackets and lap-seal adhesives as a composite product and confirm flame spread of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with UL723 or ASTM E84.
   9. Clean thoroughly, test and have approved, all piping and equipment before installing insulation and/or covering.
   10. Repair all damage to existing pipe and equipment insulation whether or not caused during the work of this contract, to match existing adjacent insulation for thickness and finish, but conforming to flame spread and smoke ratings specified above.

B. Insulation of Piping:
   1. Insulate domestic hot and tempered water with 1 inch thick 3-1/2# minimum density fiberglass with ASJ-SSL jacket for sizes up to and including 3/4 inches. For larger sizes, provide 1-1/2 inch thick 3-1/2# minimum density fiberglass insulation and ASJ-SSL jacket.
2. Insulate domestic hot water piping under slab on grade and cold water piping exposed to the weather with 3/4" thick Therma-Cel, Armaflex, or equal; seal water tight per manufacturer’s directions.

3. Insulate horizontal, overhead rainwater leaders and condensate drains within the building envelope with 1 inch thick, 3-1/2# density fiberglass, with ASJ-SSL jacket.

4. Insulate domestic cold water piping outside of insulation envelope in outside walls, vented attic spaces, and unheated spaces, including equipment rooms and below raised floor with 1 inch thick molded fiberglass, minimum density 3-1/2# per cubic foot, with ASJ-SSL jacket.

5. Exposed insulated piping within the building shall have a Zeston 2000 25/50, Proto Lo-Smoke, or equal, PVC jacket and fitting cover installed over the insulation, applied per manufacturer’s instructions. Verify suitability with manufacturer of insulation. Insulation with pre-applied polymer jacket may be substituted at Contractor’s option.

6. Where insulated piping is exposed to the weather apply aluminum jacket secured with 1/2 inch aluminum bands on 12 inch centers. Cover fittings with glass cloth and two coats of Foster’s Seaflas 30-36, Zeston 2000, or equal, PVC fitting covers. Insulation shall be vapor tight before applying metal jacket or PVC covers.
   a. Pipes 10 inches diameter and smaller: Minimum .016 inch thick jacket.
   b. Pipes 12 inches diameter and larger: Minimum .020 inch thick jacket.

PART 3 EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Sections “Cutting and Patching” and “Selective Demolition” for general demolition requirements and procedures.

B. Disconnect, dismantle and remove mechanical systems, equipment, and components indicated to be removed. Coordinate with all other trades.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping to remain with same or compatible piping material. Refrigerant system must be evacuated per EPA requirements.
   3. Equipment to Be Removed: Drain down and cap remaining services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 ELECTRICAL REQUIREMENTS

A. Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the Mechanical Work with the Electrical Work to comply.

B. Furnish necessary control diagrams and instructions for the controls. Before permitting operation of any equipment which is furnished, installed, or modified under this Section, review all associated electrical work, including overload protection devices, and assume complete responsibility for the correctness of the electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers'
Association. All equipment and connections exposed to the weather shall be NEMA IIIR with factory-wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.

C. All line voltage and low voltage wiring and conduit associated with the Temperature Control System are included in this Section. Wiring and conduit shall comply with Division 26.

3.3 PIPING SYSTEM REQUIREMENTS

A. Drawing plans, schematic and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

3.4 PRIMING AND PAINTING

A. Perform all priming and painting on the equipment and materials as specified herein.

B. Priming:
   1. Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed. Black steel pipe exposed to the weather shall be painted one coat of Rust-Oleum #1069 primer for black steel piping or Rust-Oleum #5260, Kelly Moore, or equal, primer for galvanized piping.
   2. Metal surfaces of items to be jacketed or insulated except piping shall be given two coats of primer unless furnished with equivalent factory finish. Items to be primed shall be properly cleaned by effective means free of rust, dirt, scale, grease and other deleterious matter and then primed with the best available grade of zinc rich primer. After erection or installation, all primed surfaces shall be properly cleaned of any foreign or deleterious matter that might impair proper bonding of subsequent paint coatings. Any abrasion or other damage to the shop or field prime coat shall be properly repaired and touched up with the same material used for the original priming.
   3. Where equipment is provided with nameplate data, the nameplate should be masked off prior to painting. When painting is completed, remove masking material.

C. See Painting Section for detailed requirements.

3.5 INSTALLATION OF VALVES

A. Install valves as indicated on Drawings and in the following locations:
   1. Shutoff Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.
   2. Drain Valves: Install on each plumbing equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere indicated or required to completely drain potable water system.
   3. Provide ball valves or globe valves on inlet and outlet of each water heater or pump.

B. General:
   1. Valves shall be full line size unless indicated otherwise on Drawings.
   2. Install horizontal valves with valve stem above horizontal, except butterfly valves.
   3. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
   4. Locate valves for easy access and provide separate support where necessary.
   5. Install valves in position to allow full stem movement.
6. Install exposed polished or enameled connections with special care showing no tool marks or exposed threads.
7. Butterfly valves conforming to the paragraph "Butterfly Valves" may be used in lieu of globe valves for locations above grade.
8. Ball valves conforming to the paragraph "Ball Valves" may be used for locations above grade for services 2-1/2 inches and smaller.
9. Valves 2-1/2 inches and smaller (except ball valves) in nonferrous water piping systems may be solder joint type with bronze body and trim.
10. Rigidly fasten hose bibbs, hydrants, fixture stops, compressed air outlets, and similar items to the building construction.

C. Valve Adjustment: Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.6 INSTALLATION OF PIPING SYSTEMS

A. At time of final connection, and prior to opening valve to allow pressurization of water and gas piping from existing systems, on site or off site, perform a pressure test to indicate static pressure of existing systems. If pressure on water piping is greater than 80 psi, or gas pressure is not as indicated on Contract Documents, inform Architect immediately. Do not allow piping systems to be pressurized without written consent of the Architect.

B. General:
1. All piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.
2. Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.
3. Install piping to permit application of insulation and to allow valve servicing.
4. Where piping or conduit is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.
5. Horizontal runs of pipes and/or electrical conduit suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.
6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.
7. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.
8. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.
9. Install horizontal valves with valve stem above horizontal.
10. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.
11. Verify final equipment locations for roughing-in.
12. Furnish and install anchors or thrust blocks on PVC water lines in the ground, at all changes in direction of piping, and at all connections or branches from mains 1-1/2 inch and larger. Form anchors or thrust blocks by pouring concrete between pipe and trench wall. Thrust blocks shall be of adequate size and so placed as to take thrusts created by maximum internal water pressure. Sizing and placement shall be per manufacturer's recommendations, CPC, and IAPMO installation standards. Anchor piping to building construction.
13. Sanitary Sewer and Storm Drain: Grade piping inside building uniformly 1/4 inch per foot if possible but not less than 1/8 inch per foot. Run piping as straight as possible. Make piping connections between building piping and outside service pipe with cast iron reducers or

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increasers. Slope sewers uniformly between given elevations where invert elevations are shown.

14. Where piping is installed in walls within one inch of the face of stud, provide a 16 gauge sheet metal shield plate on the face of the stud. The shield plate shall extend a minimum of 1-1/2 inches beyond the outside diameter of the pipe.

C. Expansion Loops:
1. Install expansion loops where piping crosses building expansion or seismic joints, between buildings, between buildings and canopies, and as indicated on Drawings.
2. Install expansion loops of sizes matching sizes of connected piping.
3. Install grooved-joint expansion joints to grooved-end steel piping.
4. Materials of construction and end fitting type shall be consistent with pipe material and type of gas or liquid conveyed by the piping system in which expansion loop is installed.

D. Sleeves:
1. Install Adjus-to-Crete, Pipeline Seal and Insulator, or equal, pipe sleeves of sufficient size to allow for free motion of pipe, 24 gauge galvanized steel. The space between pipe and sleeves through floor slabs on ground, through outside walls above or below grade, through roof, and other locations as directed shall be caulked with oakum and mastic and made watertight. The space between pipe and sleeve and between sleeve and slab or wall shall be sealed watertight.
2. At Contractor’s option, Link-Seal, Metraflex Metraseal, or equal, casing seals may be used in lieu of caulking. Wrap pipes through slabs on grade with 1 inch thick fiberglass insulation to completely isolate the pipe from the concrete.

E. Floor, Wall, and Ceiling Plates:
1. Fit all pipes with or without insulation passing through walls, floors, or ceilings, and all hanger rods penetrating finished ceilings with chrome-plated or stainless escutcheon plates.

F. Firestopping:
1. Pack the annular space between the pipe sleeves and the pipe through all floors and walls with UL listed fire stop, and sealed at the ends. All pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.
   a. Install fire caulking behind mechanical services installed within fire rated walls, to maintain continuous rating of wall construction.
2. Provide SpecSeal Systems UL fire rated sleeve/coupling penetrators for each pipe penetration or fixture opening passing through floors, walls, partitions or floor/ceiling assemblies. All Penetrators shall comply with UL Fire Resistance Directory (Latest Edition), and in accordance with Chapter 7, CBC requirements.
3. Sleeve penetrators shall have a built in anchor ring for waterproofing and anchoring into concrete pours or use the special fit cored hole penetrator for cored holes.
4. Copper and steel piping shall have SpecSeal plugs on both sides of the penetrator to reduce noise and to provide waterproofing.
5. All above Systems to be installed in strict accordance with manufacturer’s instructions.
6. Alternate firestopping systems are acceptable if approved equal. However, any deviation from the above specification requires the Contractor to be responsible for determining the suitability of the proposed products and their intended use, and the Contractor shall assume all risks and liabilities whatsoever in connection therewith.

G. Flashing:
1. Flashing for penetrations of metal or membrane roof for mechanical items such as flues and pipes shall be coordinated with the roofing manufacturer and roofing installer for the specific roofing type. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.
a. Furnish and install flashing and counterflashing in strict conformance with the requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.

b. Furnish and install counterflashing above each flashing required. Provide Stoneman, or equal, vandalproof top and flashing combination. Provide vandalproof top for each plumbing vent through roof. Elmdor/Stoneman Model 1540, 1550, 1570, or equal.

2. For all other types of roofing system, furnish and install around each pipe, where it passes through roof, a flashing and counterflashing. All flashing shall be made of four pound seamless sheet lead with 6 inch minimum skirt and steel reinforced boot. Counterflashing shall be cast iron. For vents, provide vandalproof top and flashing combination. Elmdor/Stoneman Model 1100-4, 1100-5, 1100-7, or equal.

H. Hangers and Supports:

1. General: Support all equipment and piping so that it is firmly held in place by approved iron hangers and supports and special hangers as required. All components shall support weight of equipment and pipe, fluid, and pipe insulation based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Pipe attachments or hangers, of same size as pipe or tubing on which used, or nearest available. Rigidly fasten hose faucets, fixture stops, compressed air outlets, and similar items to the building construction. The Architect shall approve all hanger material before installation. Do not support piping with plumbers' tape, wire rope, wood, or other makeshift devices. Where building structural members do not match piping support spacing, provide all "bridging" support members as required firmly attached to building structural members in a fashion approved by the Structural Engineer.

a. Materials, design, and type numbers per Manufacturers' Standardization Society (MSS), Standard Practice (SP)-58.

2. All hanger components shall be provided by one manufacturer B-Line, Grinnell, Uni-Strut, Badger, or equal.

3. Hanger and Support Spacing:

a. Vertical piping support spacing: B-line #B3373 clamps attached to the pipe above each floor to rest on the floor. Provide with lead or Teflon liners on copper tubing. Provide additional support at base of cast iron risers and support at unsupported riser joints and horizontal offsets per 2007 Mason Industries Seismic Restraint Guidelines. Provide intermediate support for vertical piping, spaced at or within the following maximum limits.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Steel Fluid</th>
<th>Steel Vapor</th>
<th>Copper Fluid</th>
<th>Copper Vapor</th>
<th>CPVC &amp; PVC Base and Each Floor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 - 1&quot;</td>
<td>12</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>(Note 2)</td>
</tr>
<tr>
<td>1-1/4 - 2&quot;</td>
<td>12</td>
<td>Each Floor</td>
<td>10</td>
<td>6</td>
<td>Base and Each Floor (Note 1)</td>
</tr>
<tr>
<td>2-1/2 - 3&quot;</td>
<td>12</td>
<td>Each Floor</td>
<td>10</td>
<td>10</td>
<td>Base and Each Floor (Note 1)</td>
</tr>
<tr>
<td>Over 4&quot;</td>
<td>12</td>
<td>Each Floor</td>
<td>10</td>
<td>10</td>
<td>Base and Each Floor (Note 1)</td>
</tr>
</tbody>
</table>

Note 1: Provide mid-story guides.
Note 2: For PVC piping, provide for expansion every 30 feet per IAPMO installation standard.

b. Vertical cast iron piping support spacing: Base and each floor not to exceed 15 feet.

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c. Horizontal piping, hanger and support spacing: Locate hangers and supports at each change of direction, within one foot of elbow, and spaced at or within following maximum limits.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Steel Fluid</th>
<th>Steel Vapor</th>
<th>Copper Fluid</th>
<th>Copper Vapor</th>
<th>CPVC &amp; PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 - 1&quot;</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>1-1/4 - 2&quot;</td>
<td>7</td>
<td>10</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>2-1/2 - 3&quot;</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Over 4&quot;</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

d. Horizontal cast iron piping support spacing:
   1) Support piping at every other joint for piping length of less than 4 feet.
   2) For piping longer than 4 feet, provide support on each side of the coupling, within 18 inches of each joint.
   3) Hanger shall not be installed on the coupling.
   4) Provide support at each horizontal branch connection.
   5) Provide sway brace at 40 foot maximum spacing for all suspended pipe with no-hub joints, except where a lesser spacing is indicated in the 2007 Mason Industries Seismic Restraint Guidelines. Provide a brace on each side of a change in direction of 90 degrees or more. Brace riser joints at each floor and at 15 foot maximum intervals.

4. Individually Suspended Piping:
   a. Individually suspended piping: B-Line B3690 J-Hanger or B3100 Clevis, complete with threaded rod, or equal. All hangers on supply and return piping handling heating hot water or steam shall have a swing connector at point of support.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Rod Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and Smaller</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; to 3-1/2&quot;</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>4&quot; to 5&quot;</td>
<td>5/8&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>3/4&quot;</td>
</tr>
</tbody>
</table>

b. Trapeze Suspension: B-Line 1-5/8 inch width channel in accordance with manufacturer's published load ratings. No deflection to exceed 1/180 of a span.

c. Trapeze Supporting Rods: Shall have a safety factor of five; securely anchor to building structure.

d. Pipe Clamps and Straps: B-Line B2000, B2400; isolate copper pipe with two thicknesses of 2 inches wide 10-mil polyvinyl tape. Where used for seismic support systems, provide B-Line B2400 series pipe straps.

e. Steel Connectors: Beam clamps with retainers.

5. Support to Structure:
   a. Steel Structure: Provide and install additional steel bracing as required to suit structure. Provide through bolts with length to suit requirements of the structural components. Burring or welding on any structural member may only be done if approved by the Architect.

6. Rubber Neoprene Pipe Isolators:
   a. Pipe isolators shall comprise an internal rubber or neoprene material that isolates pipe from hanger and structure. Install at all piping located in acoustical walls. Refer to Architectural Drawings for location of acoustical walls.
   b. Isolation material shall be either a rubber or neoprene material that prevents contact between the pipe and the structure. The rubber shall have between a 45 to 55 durometer rating and a minimum thickness of 1/2 inch.

c. Acceptable Suppliers:
   1) Vertical runs: Acousto-Plumb or equal.
   2) Horizontal runs: B-Line, Vibraclamp; Acousto-Plumb or equal.

7. Provide support for piping through roof, arranged to anchor piping solidly in place at the roof penetration.

BASIC PLUMBING MATERIALS AND METHODS
22 00 50-16
8. Provide rigid insulation and a 12 inch long, 18 gauge galvanized sheet iron shield between the covering and the hanger whenever hangers are installed on the outside of the pipe covering.
9. Insulate copper tubing from ferrous materials and hangers with two thicknesses of 3 inch wide, 10 mil polyvinyl tape wrapped around pipe.
10. Provide a support or hanger close to each change of direction of pipe either horizontal or vertical and as near as possible to concentrated loads.
11. Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power actuated inserts will not be allowed.

3.7 PIPE JOINTS AND CONNECTIONS

A. General:
1. Cutting: Cut pipe and tubing square, remove rough edges or burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt and debris from inside and outside of pipe before assembly.
3. Boss or saddle type fittings or mechanically extracted tube joints will not be allowed.

B. Threaded Pipe: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply thread compound to external pipe threads: Rectorseal No. 5, Permatex No. 1, or equal.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

C. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

D. Copper Pipe and Tubing (Except pneumatic control piping): All joints shall be brazed according to ASME Section IX, Welding and Brazing Qualifications, except domestic water piping 1-1/4 inches and smaller when not buried in the ground or concrete and type DWV plumbing piping may be soldered.

E. Cast Iron Soil Pipe:
1. No-Hub fittings shall be made with a torque wrench.
2. Hub joints shall be with Ty-Seal couplings.
3. Wrought iron, steel, or copper pipe shall have a ring or part of a coupling screwed on to form a spigot end if caulked into a joint.
4. Connect cast iron sewer piping to outside service pipe with cast iron or vitrified clay reducers or increasers as required. Caulking of smaller pipe into the larger without a reducer or increaser will not be permitted.

3.8 UNIONS AND FLANGES

A. Install Watts, Epco, Nibco, or equal, dielectric unions or flanges at points of connection between copper or brass piping or material and steel or cast iron pipe or material except in drain, waste, vent, or rainwater piping. Bushings or couplings shall not be used. Dielectric unions installed in potable water systems shall conform to the lead-free requirements of the California Health and Safety Code Section 11 68 75.
B. Install unions in piping NPS 2" and smaller, and flanges in piping NPS 2-1/2" and larger whether shown or not at each connection to all equipment and tanks, and at all connections to all automatic valves, such as temperature control valves. Unions installed in potable water systems shall conform to the lead-free requirements of the California Health and Safety Code Section 11 68.75.

C. Locate the unions for easy removal of the equipment, tank, or valve.

3.9 ACCESS DOOR

A. Furnish and install access doors wherever required whether shown or not for easy maintenance of mechanical systems; for example, at concealed valves, strainers, traps, cleanouts, dampers, motors, controls, operating equipment, etc. Access doors shall provide for complete removal and replacement of equipment.

3.10 PIPE IDENTIFICATION

A. Provide temporary identification of each pipe installed, at the time of installation. Temporary identification shall be removed and replaced with permanent identification as part of the work.

B. Apply the legend and flow arrow at all valve locations; at all points where the piping enters or leaves a wall, partition, cluster of piping or similar obstruction, at each change of direction and at approximately 20'-0" intervals on pipe runs. Variations or changes in locations and spacing may be made with the approval of the Architect. There shall be at least one marking in each room. Markings shall be located for maximum visibility from expected personnel approach.

C. Wherever two or more pipes run parallel, the markings shall be supplied in the same relative location on each.

D. Apply markings after painting and cleaning of piping and insulation is completed.

3.11 EXPANSION ANCHORS IN HARDENED CONCRETE

A. Refer to Structural Drawings.

B. Qualification Tests: The specific anchor shall have a current ICC-ES report and evaluated in cracked concrete in accordance with Acceptance Criteria AC193. If the specific anchor satisfies cyclic testing requirements per Acceptance Criteria AC01, Section 5.6, the full allowable shear and tension loads listed in the current ICC-ES report and manufacturer's recommendations for the specific anchor may be used. Otherwise, the design shear and tension loads shall not be more than 80% of the listed allowable shear and tension loads for the specific anchor.

C. Installation: The anchors must be installed in accordance with the requirements given in ICC Research Committee Recommendations for the specific anchor.

D. Testing: Fifty percent of the anchors shall be load-tested on each job to twice the allowable capacity in tension, except that if the design load is less than 75 pounds; only one anchor in ten need be tested. If any anchor fails, all anchors must be tested. The load test shall be performed in the presence of a special inspector.

E. The load may be applied by any method that will effectively measure the tension in the anchor, such as direct pull with a hydraulic jack, a torque wrench calibrated using the specific anchor or calibrated spring-loading devices. Anchors in which the torque is used to expand the anchor without applying tension to the bolt may not be verified with a torque wrench.
3.12 TESTS AND ADJUSTMENTS

A. Test the installations in accordance with the following requirements and all applicable codes:
   1. Inspector of Record should witness all tests of piping systems.
   2. Notify the Architect at least seven days in advance of any test.
   3. All piping shall be tested at completion of roughing-in, or at other times as directed by the Architect.
   4. Furnish all necessary materials, test pumps, gases, instruments and labor required for testing.
   5. Isolate from the system all equipment that may be damaged by test pressure.

B. Test Schedule: No loss in pressure or visible leaks shall show after four hours at the pressures indicated.

C. Testing of Sanitary Sewer, Drain, Vent, Storm Drain may be done in segments in order to limit pressure to within manufacturer's recommendations. Test to 10 feet above the highest point in the system.

<table>
<thead>
<tr>
<th>System Tested</th>
<th>Test Pressure PSI</th>
<th>Test With</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitary Sewer, Drain, Vent</td>
<td>10 Ft. Hd.</td>
<td>Water</td>
</tr>
<tr>
<td>Storm Drain</td>
<td>10 Ft. Hd.</td>
<td>Water</td>
</tr>
<tr>
<td>Domestic Water</td>
<td>125</td>
<td>Water</td>
</tr>
</tbody>
</table>

D. Perform operational tests under simulated or actual service conditions, including one test of complete plumbing installation with all fixtures and other appliances connected, and one test of complete installation of 48 hours each for heating and cooling with all equipment connected and operating.

E. Should any material or work fail in any of these tests, it shall be immediately removed and replaced for new material, and portion of the work replaced shall again be tested by Contractor at his own expense.

F. Lubricate each item of equipment, including motors, before operation.

3.13 CERTIFICATES OF INSTALLATION

A. Contractor shall complete applicable "Certificates of Installation" forms contained in the California Building Energy Efficiency Standards and submit to the authorities having jurisdiction for approval and issuance of final occupancy permit, as described in the California Energy Code.

3.14 DEMONSTRATION AND TRAINING

A. An authorized representative of the equipment manufacturer shall train Owner-designated personnel in maintenance and adjustment of equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the Owner training for the equipment installed.
   1. As part of the submittal process, provide a training agenda outlining major topics and time allowed for each topic.
2. Some items of specified equipment require that training must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.

3. Contractor shall provide three copies of certification by Contractor that training has been completed, signed by Owner's representative, for inclusion in Operation and Maintenance Manual. Certificates shall include:
   a. Listing of Owner-designated personnel completing training, by name and title.
   b. Name and title of training instructor.
   c. Date(s) of training.
   d. List of topics covered in training sessions.

4. Refer to specific equipment Articles for minimum training period duration for each piece of equipment.

END OF SECTION
SECTION 22 10 00

PLUMBING PIPING SYSTEMS

PART 1  GENERAL

1.1 SECTION INCLUDES

A. Pipe and fittings.
B. Water hammer arrestors.
C. Hose bibbs.
D. Trap primer.
E. Cleanouts.
F. Floor drains.
G. Floor sinks.
H. Hopper drains.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary
   Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 22 00 50 Basic Plumbing Materials and Methods.

1.3 ADDITIONAL REQUIREMENTS

A. Furnish and install any incidental work not shown or specified which is necessary to provide a
   complete and workable system.

B. Coordinate all of work in this Section with all of the trades covered in other Sections of the
   Specifications to provide a complete, operable and sanitary installation of the highest quality
   workmanship.

C. All plumbing work required in the course of this contract shall be performed in strict accordance
   with all codes and regulations. Plumbing work done under this contract shall not adversely affect
   the operation of the existing plumbing systems. All materials shall be new and shall match
   existing.

1.4 DESCRIPTION OF WORK

A. Furnish and install all plumbing work indicated on the drawings and described herein.

1.5 QUALITY ASSURANCE
A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of plumbing piping systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with piping systems work similar to that required for project.

C. Requirements of Regulatory Agencies: The publications listed below form a part of this specification; comply with provisions of these publications except as otherwise shown or specified.

1. Plumbing Code Compliance: Comply with applicable portions of California Plumbing Code pertaining to selection and installation of plumbing materials and products.
   a. NSF Compliance:
      1) Pipe, tube, and fittings used in potable water systems intended to supply drinking water shall meet the requirements of NSF-61 2010a, "Drinking Water System Components – Health Effects."
      2) Plastic potable water-service piping shall meet the requirements of NSF 14 2010, "Plastic Piping Components and Related Materials."

2. California Health and Safety Code Compliance: For products covered under the scope of HSC 116875 for potable water service. Products for potable water service shall be third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for plumbing piping systems materials and products.

B. Record Drawings: At project closeout, submit Record Drawings of installed piping systems, in accordance with requirements of Division 01.

C. Maintenance Data: Submit maintenance data and parts lists for plumbing piping systems materials and products. Include this data, product data, shop drawings, and record drawings in Operation and Maintenance Manual; in accordance with requirements of Division 01.

D. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of the California Health and Safety Code Section 11 68 75. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.

1.7 JOB CONDITIONS

A. Cooperation with other trades: Coordinate Work of this Section with that of other Sections to ensure that Work is carried out in an orderly fashion.

B. Coordinate with other trades all equipment locations, pipe, duct and conduit runs, electrical outlets and fixtures, air inlets and outlets, and structural and architectural features. Provide information on location of piping and seismic bracing to all other trades as required for a completely coordinated project.

PART 2 PRODUCTS

2.1 MATERIALS AND PRODUCTS
A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Provide materials and products complying with California Plumbing Code. Where more than one type of material or product is indicated, selection from materials or products specified is Contractor's option.

2.2 PIPE AND FITTINGS INSIDE BUILDINGS AND BELOW COVERED WALKS AND CORRIDORS

A. Drain and Waste Pipe Above Grade: Cast iron soil pipe and fittings, asphaltec coated, conforming to ASTM A888 and Cast Iron Soil Pipe Institute Standard (CISPI) 301 and so marked. Pipe and fittings shall be as manufactured by AB&I, Charlotte, Tyler Pipe, or equal. Pipe and fittings shall be the products of a single manufacturer. At Contractor's option, vertical piping above floor from lavatories, sinks, and drinking fountains may be Schedule 40 galvanized steel pipe with black cast iron drainage fittings, or DWV copper pipe and fittings.

1. Joints above grade: No-Hub pipe conforming to ASTM A888 and CISPI 301. Couplings conforming to ASTM 1277 and CISPI 310, with stainless steel bands. Provide products by ANACO-Husky, Tyler, Ideal or equal. Provide sway brace at 20'-0" maximum spacing for suspended pipe with No-Hub joints. Provide a brace on each side of a change in direction of 90 degrees or more. Brace riser joints at each floor and at 15 foot maximum intervals (also see Specification Section 22 00 50).

B. Drain and Waste Pipe Below Grade: Cast iron soil pipe and fittings, asphaltec coated, conforming to ASTM A888 and CISPI 301 and so marked. Pipe and fittings shall be as manufactured by AB&I, Charlotte, Tyler Pipe, or equal. Pipe and fittings shall be the products of a single manufacturer. At Contractor's option, hub and spigot cast iron soil pipe and fittings, asphaltec coated, conforming to ASTM A-74 and so marked, may be used.

1. Joints below grade: ANACO-Husky SD 4000, Clamp-AI 125, or equal couplings and No-Hub fittings, meeting the requirements of FM 1680, SD Class I and ASTM C1540.

2. Joints below grade (hub and spigot option): neoprene gaskets conforming to ASTM C564, as manufactured by Ty-Seal, Dual-Tite, or equal.

C. Vent Pipe:

1. 3 inch and larger: Cast iron soil pipe and fittings conforming to ASTM A888 and Cast Iron Soil Pipe Institute Standard 301 and so marked.

2. 2-1/2 inch and smaller: Schedule 40 galvanized steel pipe with black cast iron drainage fittings, or DWV copper pipe and fittings.

3. Vent pipe buried in ground and to 6 inches above ground: Cast iron soil pipe and fittings conforming to ASTM A888 and Cast Iron Soil Pipe Institute Standard 301 and so marked. Joints in cast iron vent pipe shall be the same as specified for cast iron waste pipe below ground.

D. Type DWV copper tubing or No-Hub cast iron pipe and fittings may be used for concealed rainwater leaders. Where no-hub piping is used, the fittings and couplings shall match those used for waste piping.

E. Water Pipe (Tempered Water, Tempered Water Return, Hot Water, Hot Water Return and Cold Water): ASTM B88, Type L copper tubing, hard-temper, with wrought copper fittings. Provide full solder cup for all fittings. Capped or plugged outlets shall be Schedule 40 screwed brass. Water piping below slab: ASTM B88, Type K copper tubing, hard temper, with wrought copper fittings. At Contractor's option, pipe runs below slab having no branches may be ASTM B88, Type K annealed copper tubing without joints. See Section 22 00 50 for pipe protection requirements for below slab copper piping.

2.3 WATER HAMMER ARRESTORS
A. Provide water hammer arrestors conforming to lead-free requirements of California Health and Safety Code Section 116875, with nesting type bellows contained within a casing having sufficient displacement volume to dissipate the calculated kinetic energy generated in the piping system. Water hammer arrestors shall be sized for type and number of fixtures served. Provide all stainless steel shell construction with stainless steel bellows and threaded connection to water system.

B. Water hammer arrestors shall be certified under P.D.I. Standard WH201 and by ASSE Standard 1010.

C. Select units in accordance with the requirements of Plumbing and Drainage Institute Standard P.D.I. WH201. Install above ceilings or behind wall access door at each plumbing fixture, or where plumbing fixtures are installed in groups, at each group of fixtures.

D. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
   Josam Company, series 75000
   Smith (Jay R.) Mfg. Co., Hydrotrol 5005-5050
   Mifab, series WHB

2.4 HOSE BIBBS

A. Hose Bibbs:
   1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
      Acorn Engineering Co.
      Woodford Manufacturing Co.

2.5 TRAP PRIMER

A. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
   MiFab, Inc.
   Precision Plumbing Products
   Sioux Chief Manufacturing Company

2.6 CLEANOUTS

A. General: Install cleanouts of same diameter as pipe (4 inch maximum) in all horizontal soil and waste lines where indicated and at all points of change in direction. Cleanouts shall be located not less than 18 inches from building construction so as to provide sufficient space for rodding. No horizontal run over 50 feet inside buildings or 100 feet outside buildings shall be without cleanout, whether shown on Drawings or not. Provide two-way cleanouts where indicated on drawings, and where required for satisfactory use.
   1. Provide cleanouts in waste drop from each sink and urinal.
   2. Provide one wrench for each size and type of cleanout used. Turn over to Owner at completion of the project, and obtain receipt. Place receipt in Operation and Maintenance Manuals.
B. Cleanouts in floor and in concrete sidewalks: Duco Cast iron with nickel bronze top, clamping collar and ABS plastic plug: Zurn ZN-1400-KC, or equal, with square or round top to suit floor construction.

C. Cleanouts in composition floors: Zurn ZN-1400-X-DX, or equal (nickel bronze top).

D. Cleanouts in concealed, aboveground cast-iron soil or waste lines: Zurn Z-1440A, or equal, with ABS plastic plug.

E. Cleanouts in walls: Zurn Z-1441 or Z-1443, or equal, with stainless steel cover. Provide long sweep elbow or combination wye at connection to riser and install with surface of cleanout within 1/2 inch of front face of finished wall.
   1. Where space does not permit the above installation, provide Zurn Z-1446, or equal, with stainless steel access cover, and vandal resistant screw.
   2. Install face of cleanout plug within 1/2 inch of front face of finished wall.

F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

   Zurn

   J.R. Smith

   Josam

2.7 FLOOR DRAINS

A. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:

   Zurn

   J.R. Smith

   Josam

2.8 FLOOR SINKS

A. Floor Sinks: Provide anchoring flange (seepage pan) at all floor sinks, and provide flashing clamp in locations where floor membrane is used. Provide cast iron "P" trap and trap primer connection at P-Trap.

B. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:

   Zurn

   J.R. Smith

   Josam
2.9 HOPPER DRAINS

A. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:

   Zurn

   J.R. Smith

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which plumbing piping systems are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Contractor.

B. Make all arrangements for the utilities required. Pay all costs involved in obtaining the services including gas service and meter, water meter, pressure reducing valve, access boxes, street work. Connect to site utilities. Verify the location of all services. No extra cost will be allowed if services are not as shown.

C. At time of final connection, and prior to opening valve to allow pressurization of water and gas piping from existing systems, on site or off site, perform a pressure test to indicate static pressure of existing systems. If pressure on water piping is greater than 80 psi, or gas pressure is not as indicated on Contract Documents, inform Architect immediately. Do not allow piping systems to be pressurized without written consent of the Architect.

3.2 INSTALLATION OF WATER PIPING

A. Run all water piping generally level, free of traps or unnecessary bends, arranged to conform to the building requirements, and to suit clearance for other mechanical work such as ducts, flues, conduits, and other work. No piping shall be installed so as to cause unusual noise from the flow of water therein under normal conditions.

B. Provide manufactured water hammer arrestors, sized and installed in accordance with Plumbing and Drainage Institute Standard PDI WH201.
   1. Locate water hammer arrestors at every plumbing fixture, or, where fixtures are located in groups, at every group of fixtures, and as indicated on Drawings.
   2. Install water hammer arresters above accessible ceilings, or install access doors for service.

C. Install piping on room side of building insulation.

D. Check final location of rubber rings within couplings on PVC water piping with gauge or as recommended by manufacturer. Make connection to valves with cast iron adapters connected to water pipe with cast iron couplings. Furnish and install anchors or thrust blocks.

3.3 INSTALLATION OF SANITARY AND STORM DRAINAGE SYSTEMS

A. Sewer Piping: Run all horizontal sanitary drain piping inside of building on a uniform grade of not less than 1/4 inch per foot unless otherwise noted or later approved. Unless otherwise noted on the plans, piping shall have invert elevations as shown and slope uniformly between given elevations.
B. Storm Drain Piping: Run all horizontal storm drain piping inside of building on a uniform grade of not less than 1/4 inch per foot. Unless otherwise noted on the plans, piping shall have invert elevations as shown and slope uniformly between given elevations.

C. Run all drainage piping as straight as possible and provide easy bends with long turns; make all offsets at an angle of 45 degrees or less.

D. Grade all vent piping so as to free itself quickly of any water condensation.

E. Where possible, join groups of vent risers together with one enlarged outlet through roof. Maintain minimum of 10 foot horizontal or 3 foot vertical clearance from air intakes.

F. Hubless Cast Iron Joints: Comply with coupling manufacturer's installation instructions.

3.4 INSTALLATION OF CLEANOUTS

A. Cleanouts: Install in piping as indicated, as required by California Plumbing Code, at each change in direction of piping greater than 45 degrees. Install at maximum intervals of 50 feet for piping 4 inches and smaller and 100 feet for larger piping inside buildings, and at base of each conductor.

B. Flashing Flanges: Install flashing flange and clamping device with each cleanout passing through water resistant membrane.

3.5 INSTALLATION OF HOPPER DRAINS

A. Install hopper drain in wall, in sheet metal box, with access door.
   1. Size access door and box to suit the size required for hopper drain and trap primer, and solder all seams of box. Seal all penetrations to box with non-hardening waterproof sealant. Provide locking door in occupied spaces.

B. Grind top and sides of funnel, if required, to suit wall thickness.

3.6 INSTALLATION OF TRAP PRIMERS

A. Install as indicated in manufacturers printed literature, with 1/2 inch, Type L, hard copper piping to trap primer connection on floor drains and floor sinks where indicated on Drawings. At Contractor's option, Type K annealed copper tubing without joints may be used below slab only. See Section 22 00 50 for pipe protection requirements for below slab copper piping/tubing.

B. Install trap primer piping with 1/4 inch per foot slope, to insure that the line will drain fully to the floor drain or floor sink.
   1. Provide ball valve to the inlet at each trap primer location.

C. Install trap primer and distribution unit exactly as called for in manufacturers printed installation instructions. Connect to domestic water piping from the top of the water line, in order to prevent foreign material from entering directly into primer assembly.

D. Mount trap primer in wall, in sheet metal box, with Karp or equal access door. Size access door and box to suit valve operation, and solder all seams of box. Seal all penetrations to box with non-hardening waterproof sealant. Provide locking door where installed in occupied spaces.
E. Where one trap primer will be used for more than one trap, provide a distribution unit with feeder piping for a maximum of four traps sized for equal pressure drop to each trap.

3.7 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated.

B. Mechanical Equipment Connections: Connect hot and cold water piping system and gas piping system to mechanical equipment as indicated, and provide with shutoff valve and union for each connection.

3.8 SPARE PARTS

A. Furnish to Owner, with receipt, one valve key for each key operated hydrant, bibb, or faucet installed.

3.9 DOMESTIC WATER SYSTEM STERILIZATION

A. Clean and disinfect new or altered hot and cold water piping connected to domestic water systems using methods prescribed by the Health Authority. If the Health Authority does not prescribe methods, clean and disinfect new or altered hot and cold water piping using methods given in the California Plumbing Code.
   1. A water treatment company that has a current state EPA license to apply disinfectant chlorine in potable water shall perform the procedure.

3.10 CARE AND CLEANING

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust equipment, fixtures, and trim that are installed as part of this work. Remove labels from stainless steel sinks, except 316 stainless steel sink labels should be retained to confirm that the correct material has been provided. Leave systems and equipment in satisfactory operating condition.

3.11 OPERATION TEST

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.12 TESTING AND BALANCING

A. See Section 23 05 93 of these specifications for testing and balancing requirements.

3.13 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION
SECTION 22 40 00

PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water supplies and stops.
B. Plumbing fixture hangers and supports.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 22 00 50 Basic Plumbing Materials and Methods.

1.3 ADDITIONAL REQUIREMENTS

A. Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.
B. Coordinate all of work in this Section with all of the Trades covered in other Sections of the Specifications to provide a complete, operable and sanitary installation of the highest quality workmanship.

1.4 DESCRIPTION OF WORK

A. Furnish and install all plumbing work indicated on the Drawings and described herein.

1.5 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of plumbing fixtures of the type, style and configuration required. All companies providing products with warranties must have been engaged in manufacturing of such products for as long as the warranty states.
B. Plumbing Fixture Standards: Comply with applicable portions of the following codes and requirements for all work in this section:
   California Building Code – CBC
   California Plumbing Code – CPC
   California Health and Safety Code
   American National Standards Institute - ANSI
   Federal Standards - F.S.
   National Sanitary Foundation – NSF International
D. PDI Compliance: Comply with standards established by Plumbing and Drainage Institute pertaining to plumbing fixture supports.
E. Americans with Disabilities Act (ADA).

F. California Health and Safety Code Compliance: For products covered under the scope of HSC 116875 for potable water service. Products for potable water service shall be third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's specifications for plumbing fixtures and trim, including catalog cut of each fixture type and trim item furnished.

B. Maintenance Data: Submit maintenance data and parts lists for each fixture type and trim item, including instructions for care of finishes. Include this data in Operation and Maintenance Manual.

C. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of the California Health and Safety Code Section 11 68 75. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.

1.7 QUALITY ASSURANCE

A. California Green Building Standards Code Requirements:

PART 2 PRODUCTS

2.1 PLUMBING FIXTURES

A. General: Provide factory fabricated fixtures of type, style and material indicated. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by the manufacturer, and as required for a complete, installation. Where more than one type is dedicated, selection is Contractor's option; but, all fixtures of same type must be furnished by single manufacturer.

1. Take special care with the roughing-in and finished plumbing where batteries of fixtures occur.
2. Take location and mounting heights for roughing-in from Architectural Drawings.
3. Follow schedule on Plumbing Drawings for roughing-in connections. Set roughing-in for all fixtures exactly as per measurements furnished by the manufacturers of the fixtures used.
4. Roughing-in for lavatories and sinks shall be brought in through the wall under the centerline of the drain from the fixture wherever possible and as close to the fixture as possible.

2.2 MATERIALS

A. Provide materials that have been selected for their surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, foundry sand holes, stains, discoloration, or other surface imperfections on finished units are not acceptable.

B. Where fittings, trim and accessories are exposed or semi-exposed, provide, chromium plated 17 gauge seamless brass and match faucets and fittings. Provide 17 gauge seamless copper or brass where not exposed.

C. Handles on all faucets and stops shall be all metal chromium plated.

PLUMBING FIXTURES

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2.3 PLUMBING FITTINGS, TRIM AND ACCESSORIES

A. Water Outlets: At locations where water is supplied (by manual, automatic or remote control), provide commercial quality faucets, valves, or dispensing devices, of type and size indicated, and as required to operate as indicated.
   1. Include manual shutoff valves and connecting stem pipes to permit outlet servicing without shut-down of water supply piping systems.

B. P-Traps: Include IAPMO approved removable P-traps where drains are indicated for direct connection to drainage system. P-Traps shall be less trap screw cleanout, and incorporate a chrome plated cast brass body, brass connection nuts, 17 gauge seamless brass wall return and chrome plated wall escutcheon to match trap finish.

C. Carriers: Provide cast iron supports for fixtures of graphitic gray iron, ductile iron, or malleable iron as indicated. Where the carrier for wall mounted water closets are installed more than 6 inches behind the finished wall, provide water closet support for wide pipe chase.

D. Fixture Bolt Caps: Provide manufacturer's standard exposed fixture bolt caps finished to match fixture finish.

E. Escutcheons: Where fixture supplies and drains penetrate walls in exposed location, provide chrome-plated cast brass escutcheons with setscrews.

F. Aerators: Provide aerators of types approved by Health Departments having jurisdiction. Delete aerators where not allowed by CPC for health care occupancies.

G. Comply with additional fixture requirements contained in Fixture Schedule shown on the drawings.

2.4 MANUFACTURERS

A. In accordance with California Plumbing Code, provide indelibly marked or embossed manufacturers name or logo, arranged so as to be visible after installation.

B. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following:
   1. Vitrified China Plumbing Fixtures:
      American Standard, U.S. Plumbing Products
      Crane Plumbing
      Eljer Plumbingware Div., Wallace-Murray Corp.
      Kohler Co.
      VitRA
   2. Plumbing Trim:
      McGuire Manufacturing Co., Inc.
      Delta Commercial
      Chicago Faucet Co.
      T&S Brass and Bronze Works, Inc.
   3. Flush Valves:
      Sloan Valve Co.
      Zurn Industries, Hydromechanics Div.
      Toto USA, Inc.
   4. Faucets:
      Chicago Faucet Co.
2.5 FLUSH VALVE REQUIREMENTS

A. Electronic flush valves where required and specified shall be non-hold open type with exposed parts chrome plated. Conform to all codes and manufacturers’ recommendations. All diaphragms are to have multiple filtered by pass and be chloramine and resistant synthetic rubber with rubber and internal components suitable for 180 degree hot water to 150 pounds pressure, plastic or leather diaphragm not acceptable. All flush valve solenoids and sensors shall be UL listed.

2.6 FIXTURE CONNECTIONS

A. Make connection between fixtures and flanges on soil pipe absolutely gastight and watertight with neoprene type gaskets (wall hung fixtures) or bowl wax (floor outlet fixtures). Rubber gaskets or putty will not be permitted.

B. Provide fixtures not having integral traps with P-traps of chromium-plated 17 gauge cast brass, with 17 gauge seamless brass wall return, connected to concealed waste in wall and sanitary fittings. Provide IAPMO approval for trap, and provide less trap screw cleanout.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
   Dearborn Brass, Commercial series with brass nuts
   Delta Commercial
   McGuire Manufacturing Co., Inc.
C. Connections from stacks or horizontal wastes to wall or floor finish for wastes from lavatories, urinals, sinks, and drinking fountains and connection between floor drains and traps shall be IPS 85 percent red brass pipe.

D. Unions on waste pipes on fixture side of traps may be slip or flange joints with soft rubber or lead gaskets. Traps shall rough in full size to waste and vent connection, using deep escutcheon plate to cover wall penetration. Compression adaptor extensions or sweat adaptors are not acceptable.

2.7 WATER SUPPLIES AND STOPS

A. Provide 85 percent IPS threaded red brass nipple, conforming to the lead-free requirements of California Health and Safety Code Section 11 68 75, securely anchored to building construction, for each connection to stops, hose bibbs, etc. Each fixture, except hose bibbs, shall have stop valves installed on water supply lines.

B. Provide water supplies to fixtures with compression shut-off stops with IPS inlets and lock shield-loose key handles. Provide combination fixtures with compression stop and IPS inlet on each water supply fitting. Provide lock shield-loose key handle for each stop.

C. Provide 1/2 inch riser tubes with reducing coupling for fixtures, unless otherwise noted.

D. Provide cast brass escutcheon.

E. Furnish shut-off valves on hose bibbs where directly connected to mains with no intervening valves.

F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- BrassCraft Manufacturing model SR37XC stop with 3-12AC riser and 647 escutcheon.
- McGuire Manufacturing Company, Inc. model LFH2167LK.
- Watts model LF890 203LK.

2.8 PLUMBING FIXTURE HANGERS AND SUPPORTS

A. Residential type fixture supports are not acceptable.

B. Install wall mounted water closets with combination support and waste fittings, with feet of support securely anchored to floor.

C. Install floor mounted water closets with J.R. Smith, Zurn, or equal government pattern cast iron closet flanges with brass bolts, nuts, washers, and porcelain caps secured with Spackle.

D. Install the following fixtures on concealed support with feet of support securely anchored to floor. Anchor top of support to wall construction in an approved manner.
   1. Wall hung lavatories.
   2. Wall mounted urinals.
   3. Drinking fountains.
   4. Electric water coolers.

2.9 PLUMBING FIXTURES

A. Install all plumbing fixtures at height indicated on Architectural Drawings. Where mounting height is not indicated, install at height required by Code.
B. Special Requirements For Accessible Fixtures:
   1. Operating handle or valve for accessible water closets, urinals, lavatories, and sinks shall operate with less than 5 pounds force. Metering faucets shall be adjusted to operate between 10 and 15 seconds.
   2. Insulate exposed waste piping and domestic water supplies below accessible fixtures with CBC access code compliant molded "closed-cell" vinyl covers. Covers shall be installed using vandal resistant fasteners and must be removable. Covers shall meet flame spread rating not to exceed 25 and smoke density not to exceed 50 when tested in accordance with ASTM E-84, and shall comply with the requirements of California Code of Regulations, Title 24. Plumberex – Handy Shield, Johns Manville – Zeston 2000, or equal.

PART 3 EXECUTION

3.1 PRODUCT HANDLING AND PROTECTION

   A. Deliver packaged materials in their original, unopened wrapping with labels intact. Protect materials from water, the elements and other damage during delivery, storage and handling.

3.2 PREPARATORY PROVISIONS

   A. The Contractor is responsible for the examination and acceptance of all conditions affecting the proper construction and/or installation of the Work of this Section. Do not proceed until all unsatisfactory conditions have been corrected. Commencing work will be construed as acceptance of all conditions by the Contractor as satisfactory for the construction and/or installation of the Work.

3.3 INSPECTION AND PREPARATION

   A. Examine roughing-in work of domestic water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected.

   B. Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer's written instructions, roughing-in drawings. Ensure that plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable requirements of the National Standard Plumbing Code pertaining to installation of plumbing fixtures.

   C. Fasten plumbing fixtures securely to supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies to blocking behind or within wall construction so as to be rigid, and not subject to pull or push movement.

   D. Install CBC accessible fixtures in accordance with Chapter 4 California Plumbing Code, and Chapters 11A and 11B California Building Code.

   E. Refer to Division 26 for wiring for electronic flush valves.

3.4 INSTALLATION OF FAUCETS

   A. Provide 85 percent IPS red brass pipe, conforming to lead-free requirements of California Health and Safety Code Section 11 68 75, securely anchored to building construction, for each
connection to faucets, stops, hose bibbs, etc. Each fixture, except hose bibbs, shall have a stop valve installed on water supply lines to permit repairs without shutting off water mains.

B. Adjust metering faucets to run for 10 to 15 seconds.

3.5 CLEAN AND PROTECT

A. Clean plumbing fixtures of dirt and debris upon completion of installation.

B. Protect installed fixtures from damage during the remainder of the construction period.

C. Grout voids between all fixtures and adjacent surfaces with white Dow Silicone Sealant, arranged to shed water.

3.6 FIELD QUALITY CONTROL

A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

3.7 EXTRA STOCK

A. General: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt. Furnish one device for every ten units.

END OF SECTION
SECTION 23 00 50

BASIC HVAC MATERIALS AND METHODS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Valves and fittings.
B. Strainers.
C. Access Doors.
D. Expansion loops.
E. Insulation.

1.2 RELATED DOCUMENTS

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

B. This Section is a part of each Division 23 Section.

1.3 ADDITIONAL REQUIREMENTS

A. Furnish and install incidental work not shown or specified necessary to provide a complete and workable system.

B. Make all temporary connections required to maintain services, including adequate heat and cooling, during the course of the Contract without additional cost to Owner. Notify Owner seven days in advance before disrupting services.

C. Provide for adjustments or modifications to fan and motor sheaves, belts, damper linkages, and other components as required to achieve specified air balance at no additional cost to Owner.

1.4 REFERENCED STANDARDS

A. Where material or equipment is specified to conform to referenced standards, it shall be assumed that the most recent edition of the standard in effect at the time of bid shall be used.
1. CSA – Canadian Standards Association International
2. ANSI - American National Standards Institute
3. ASTM - American Society for Testing and Materials
4. CCR - California Code of Regulations
   a. Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36
5. NCPWB - National Certified Pipe Welding Bureau
6. CEC - California Electrical Code
7. NEMA - National Electrical Manufacturers' Association
8. NFPA - National Fire Protection Association
9. OSHA - Occupational Safety and Health Act
10. UL - Underwriters' Laboratories, Inc.

1.5 DRAWINGS

A. Examine Drawings prior to bidding of work and report discrepancies in writing to Architect.

B. Visit Project site and examine existing conditions in order to become familiar with Project scope. Verify dimensions shown on Drawings at Project site. Bring discrepancies to the attention of Architect. Failure to examine Project site shall not constitute basis for claims for additional work because of lack of knowledge or location of hidden conditions that affect Project scope.

C. Drawings showing location of equipment and materials are diagrammatic and job conditions will not always permit installation in location shown. The HVAC Drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as existing conditions, actual building construction, and work of other trades permit.
   1. Architectural and Structural Drawings shall be considered part of the Work. These Drawings furnish Contractor with information relating to design and construction of the Project. Architectural Drawings take precedence over HVAC Drawings.
   2. Because of the small scale of HVAC Drawings, not all offsets, fittings, and accessories required are shown. Investigate structural and finish conditions affecting the Work and arrange Work accordingly. Provide offsets, fittings, and accessories required to meet conditions. Inform Architect immediately when job conditions do not permit installation of equipment and materials in the locations shown. Obtain the Architects approval prior to relocation of equipment and materials.
   3. Relocate equipment and materials installed without prior approval of the Architect. Remove and relocate equipment and materials at Contactors’ expense upon Architects' direction.
   4. Minor changes in locations of equipment, piping, ducts, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.

D. Execute work mentioned in the Specifications and not shown on the Drawings, or vice versa, the same as if specifically mentioned or shown in both.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. The publications listed below form part of this Specification; comply with provisions of these publications except as otherwise shown or specified.
   2. California Electrical Code, 2013
   8. California Code of Regulations, Title 24
   10. CAL-OSHA
   11. California State Fire Marshal, Title 19 CCR
   12. National Fire Protection Association
   13. Occupational Safety and Health Administration
   14. Other applicable state laws
B. Nothing in Drawings or Specifications shall be construed to permit work not conforming to these codes, or to requirements of authorities having jurisdiction. It is not the intent of Drawings or Specifications to repeat requirements of codes except where necessary for clarity.


D. When Contract Documents differ from governing codes, furnish and install larger size or higher standards called for without extra charge.

E. FEES AND PERMITS

F. Obtain and pay for permits and service required in installation of the Work. Arrange for required inspections and secure approvals from authorities having jurisdiction. Comply with requirements of Division 01.

G. Arrange for utility connections and pay charges incurred, including excess service charges.

1.7 FRAMING, CUTTING AND PATCHING

A. Special framing, recesses, chases and backing for Work of this Section, unless otherwise specified, are covered under other Specification Sections.

B. Contractor is responsible for placement of pipe sleeves, hangers, inserts, supports, and location of openings for the Work.

C. Cutting, patching, and repairing of existing construction to permit installation of equipment, and materials is the responsibility of Contractor. Repair or replace damage to existing work with skilled mechanics for each trade.

D. Cut existing concrete construction with a concrete saw. Do not utilize pneumatic devices.

E. Core openings through existing construction for passage of new piping and conduits. Cut holes of minimum diameter to suit size of pipe and associated insulation installed. Coordinate with building structure, and obtain Structural Engineer's approval prior to coring through existing construction.

1.8 SUBMITTALS

A. Submittal packages may be submitted via email as PDF electronic files, or as printed packages. PDFs shall be legible at actual size (100 percent). Provide seven copies of printed submittal packages.

B. Provide submittal of materials proposed for use as part of this Project. Product names in Specifications and on Drawings are used as standards of quality. Furnish standard items on specified equipment at no extra cost to the Contract regardless of disposition of submittal data. Other materials or methods shall not be used unless approved in writing by Architect. Architect's review will be required even though "or equal" or synonymous terms are used. Refer to Division 01 for complete instructions.
   1. Partial or incomplete submittals will not be considered.
   2. Quantities are Contractor's responsibility and will not be reviewed.
   3. Provide materials of the same brand or manufacturer for each class of equipment or material.
4. Identify each item by manufacturer, brand, trade name, number, size, rating, or other data necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.

5. Identify each submittal item by reference to items' Specification Section number and paragraph, by Drawing and detail number, and by unit tag number.

6. Organize submittals in same sequence as in Specification Sections.

7. Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, and weight.
   a. Submit Shop Drawings, performance curves, and other pertinent data, showing size and capacity of proposed materials.
   b. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of Contract Documents.
   c. Drawings shall be drawn to scale and dimensioned (except schematic diagrams). Drawings may be prepared by vendor but must be submitted as instruments of Contractor, thoroughly checked and signed by Contractor before submission to Architect for review.
   d. Catalog cuts and published material may be included with supplemental scaled drawings.

C. Review of submittals will be only for general conformance with design concept and general compliance with information given in Contract Documents. Review will not include quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with work of other trades, or construction safety precautions, which are sole responsibility of Contractor. Review of a component of an assembly does not indicate acceptance of an assembly. Deviations from Contract Documents not clearly identified by Contractor are Contractor's responsibility and will not be reviewed by Architect.

D. Within reasonable time after award of contract and in ample time to avoid delay of construction, submit to Architect shop drawings or submittals on all items of equipment and materials provided. Provide submittal as a complete package.
   1. Shop drawings and submittals shall include Specification Section, Paragraph number, and Drawing unit symbol or detail number for reference. Organize submittals into booklets for each Specification section and submit in loose-leaf binders with index. Deviations from the Contract Documents shall be prominently displayed in the front of the submittal package and referenced to the applicable Contract requirement.

E. Provide coordinated layouts for HVAC Ductwork systems, in accordance with Specification Section 23 80 00.

F. Furnish to the Project Inspector complete installation instructions on material and equipment before starting installation.

G. Have fire damper and fire smoke damper installation instructions available at Project site during construction for use by Project Inspector.

H. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.

I. Provide product data for insulation products, including insulation, insulation facings, jackets, adhesives, sealants, and coatings, indicating compliance with requirement that these products contain less than 0.1 percent (by mass) polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations.

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J. Delegated-Design Submittal: For seismic supports, anchorages, and restraints indicated to comply with performance requirements and design criteria.
2. Supports, anchorage and restraints for piping, ductwork, and equipment shall be an OSHPD pre-approved system such as Tolco, Afcon, ISAT, Badger, Mason, or equal. Pipes, ducts and equipment shall be seismically restrained in accordance with requirements of current edition of California Building Code. System shall have current OPM number and shall meet additional requirements of authority having jurisdiction. Provide supporting documentation required by the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping, ductwork and restraint locations.
   a. Bracing of Piping, Ductwork, and Equipment: Specifically state how bracing attachment to structure is accomplished. Provide shop drawings indicating seismic restraints, including details of anchorage to building. In-line equipment must be braced independently of piping and ductwork, and in conformance with applicable building codes. Provide calculations to show that pre-approval numbers have been correctly applied in accordance with general information notes of pre-approval documentation.
3. In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, ductwork, and restraint locations, and detail supports, attachments and restraints, and furnish supporting calculations and legible details sealed by a California registered structural engineer, in accordance with 2013 California Building Code
4. Additional Requirements: In addition to the above, conform to all state and local requirements.

1.9 SUBSTITUTIONS

A. Refer to Division 01 for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In case of conflict between requirements given herein and those of Division 01, Division 01 requirements shall apply.

B. It is the responsibility of Contractor to assume costs incurred because of additional work and or changes required to incorporate proposed substitute into the Project. Refer to Division 01 for complete instructions.

C. Substitutions will be interpreted to be manufacturers other than those specifically listed in the Contract Documents by brand name, model, or catalog number.

D. Only one request for substitution will be considered for each item of equipment or material.

E. Substitution requests shall include the following:
   1. Reason for substitution request.
   2. Complete submittal information as described herein; see “Submittals.”
   3. Coordinated scale layout drawings depicting position of substituted equipment in relation to other work, with required clearances for operation, maintenance and replacement.
   4. List optional features required for substituted equipment to meet functional requirements of the system as indicated in Contract Documents.
   5. Explanation of impact on connected utilities.
   6. Explanation of impact on structural supports.

F. Installation of reviewed substitution is Contractors’ responsibility. Any mechanical, electrical, structural, or other changes required for installation of substituted equipment or material must be
made by Contractor without additional cost to Owner. Review by Architect of substituted equipment or material, will not waive these requirements.

G. Contractor may be required to compensate Architect for costs related to substituted equipment or material.

1.10 OPERATION AND MAINTENANCE MANUAL

A. Furnish three complete sets of Operation and Maintenance Manual bound in hardboard binder, and one compact disc containing complete Operation and Maintenance Manual in searchable PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in binder and disc. Start compiling data upon approval of submittals.
   1. Sets shall incorporate the following:
      a. Service telephone number, address and contact person for each category of equipment or system.
      b. Complete operating instructions for each item of heating, ventilating and air conditioning equipment.
      c. Copies of guarantees/warrantees for each item of equipment or systems.
      d. Test data and system balancing reports.
      e. Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
      f. Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
      g. Temperature control diagrams and literature.
      h. Check test and start reports for each piece of mechanical equipment provided as part of the Work.
      i. Commissioning and Preliminary Operation Tests required as part of the Work.

B. Post service telephone numbers and addresses in an appropriate place designated by Architect.

1.11 SITE CONDITIONS

A. Information on Drawings relative to existing conditions is approximate. Deviations from Drawings necessary during progress of construction to conform to actual conditions shall be approved by the Architect and shall be made without additional cost to the Owner. The Contractor shall be held responsible for damage caused to existing services. Promptly notify the Architect if services are found which are not shown on Drawings.

1.12 EXISTING MATERIALS

A. Remove existing equipment, piping, wiring, construction, etc., which interferes with Work of this Contract. Promptly return to service upon completion of work in the area. Replace items damaged by Contractor with new material to match existing.

B. Removed materials which will not be re-installed and which are not claimed by Owner shall become the property of Contractor and shall be removed from the Project site. Consult Owner before removing any material from the Project site. Carefully remove materials claimed by Owner to prevent damage and deliver to Owner-designated storage location.

C. Existing piping and wiring not reused and are concealed in building construction may be abandoned in place and all ends shall be capped or plugged. Remove unused piping and wiring exposed in Equipment Rooms or occupied spaces. Material shall be removed from the premises. Disconnect power, water, gas, pump or any other active energy source from piping or electrical service prior to abandoning in place.

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1.13 WARRANTY

A. Refer to Division 01 for warranty requirements, including effective date of warranty. Refer to specific items of equipment specified herein for warranty duration if different from that specified in Division 01.

B. Repair or replace defective work, material, or part that appears within the warranty period, including damage caused by leaks.

C. On failure to comply with warranty requirements within a reasonable length of time after notification is given, Architect/Owner shall have repairs made at Contractor's expense.

1.14 RECORD DRAWINGS

A. Refer to Division 01, Record Documents, for requirements governing Work specified herein.

B. Upon completion of the Work, deliver to Architect the following:
   1. Originals of drawings showing the Work exactly as installed.
   2. One complete set of reproducible drawings showing the Work exactly as installed.
   3. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.
   4. Provide Contractor's signature, verifying accuracy of record drawings.

C. Obtain the signature of the Inspector of Record for all Record Drawings.

1.15 DELIVERY AND STORAGE

A. Protect equipment and materials delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

1.16 COORDINATION

A. General:
   1. Coordinate Work in this Section with trades covered in other Specifications Sections to provide a complete, operable and sanitary installation of the highest quality workmanship.

B. Electrical Coordination:
   1. Refer to the Electrical Drawings and Specifications, Division 26, for service voltage and power feed wiring for equipment specified under this section. Contractor has full responsibility for the following items of work:
      a. Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.
      b. If additional electrical services are required above that indicated on Electrical Drawings and in Division 26, such as more control interlock conductors, larger feeder, or separate 120 volt control power source, include cost to furnish and install additional electrical services as part of the bid.
      c. Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.

C. Mechanical Coordination:
   1. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
3. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.1 GENERAL

A. Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.

B. All sizes, capacities, and efficiency ratings shown are minimum, except that gas capacity is maximum available.

C. Refer to Division 22 10 00 and 23 80 00 for specific system piping materials.

2.2 MATERIALS

A. No material installed as part of this Work shall contain asbestos.

B. California Green Building Code Compliance:
   1. HVAC and refrigeration equipment shall not contain CFCs.
   2. HVAC and refrigeration equipment shall not contain Halons.

2.3 VALVES AND FITTINGS

A. Gate Valves:
   1. Los Medanos College requirement: gate valves are not acceptable for use on this project.

B. Ball Valves:
   1. 2 inches and smaller: 600 psi CWP, 150 psi SWP, cast bronze body, full port, two piece, threaded ends, and reinforced PTFE seal, conforming to MSS SP-110. Nibco T585-70, Milwaukee BA-400, Stockham T-285, or equal.
   2. 2-1/2 inches and larger: Class 150, carbon steel body, full port, two piece, stainless steel vented ball, flanged ends, and reinforced PTFE seal, conforming to MSS SP-72. Nibco F-515-CS-F-66-FS, Milwaukee F20-CS-15-F-02-GO-VB, or equal.
   3. Compressed Air Services: Class 150, bronze body, full port, three piece, threaded ends, and reinforced PTFE seal, conforming to MSS SP-110. Nibco Model T-595-Y, Milwaukee BA-300, or equal.

C. Calibrated Balance Valves (Symbol CBV): Provide globe style valves for precision regulation and control rated 175 psi for sizes 2-1/2 inches through 12 inches and rated 240 psi for bronze sizes 2 inches and below. Each valve shall have two metering/test ports with internal check valves and protective caps. All valves must be equipped with visual position readout and concealed memory stops for repeatable regulation and control.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
      a. Bell & Gossett Circuit Setter Plus
      b. Armstrong CBV
      c. Flow Design Inc. Accusetter
      d. Tour & Andersson
      e. Circuit Sensor with butterfly valve above 3 inches.
f. Illinois Series 5000 through 2 inches.

2.4 JOINING MATERIALS

A. Refer to Division 22 and 23 piping sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated
      a. Full-Face Type: For flat-face, Class 125, cast iron and cast bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast iron and steel flanges.
   2. AWWA C111, rubber, flat face, 1/8-inch (3.2mm) thick, unless otherwise indicated; and full-face or ring type, unless other indicated.
   3. Flange Bolts and Nuts: AWWA C111, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, 100 percent lead free alloys. Include water-flushable flux according to ASTM B813.

D. Brazing Filler Metals:
   1. General Duty: AWS A5.8, BCup-5 Series, copper-phosphorus unless otherwise indicated. Sil-Fos 15, or equal.

E. Welding Filler Metals: Comply with ASME B31.1 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 STRAINERS

A. Charles M. Bailey #100A, Armstrong, Muessco, or equal, Fig. 11 "Y" pattern, 125 psi WP minimum, with monel screens with 20 square mesh for 2 inches and smaller and 3/64 inch perforations for 2 1/2 inches and larger. Install all strainers with a blow-off hose valve with hose adapter. Strainer shall have gasketed cover with straight thread.

2.6 ACCESS DOORS

A. Where floors, walls, or ceilings must be penetrated for access to mechanical equipment, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.
   1. All access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.

B. Access doors shall match those supplied in Division 08 in all respects, except as noted herein.

C. Provide stainless steel access doors for use in toilet rooms, shower rooms, kitchens and other damp areas. Provide steel access doors with prime coat of baked-on paint for all other areas.

D. Where panels are located on ducts or plenums, provide neoprene gaskets to prevent air leakage, and use frames to set door out to flush with insulation.

E. Provide insulated doors where located in internally insulated ducts or casings.
F. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with the Architect when access is required in these areas.

G. Where specific information or details relating to access panels different from the above is shown or given on the Drawings or other Divisions of work, then that information shall supersede this specification.

H. Manufacturers: Subject to compliance with requirements, available manufacturers offering products which may be incorporated into the Work include Milcor, Karp, Nystrom, or Cesco, equal to the following:
   1. Milcor
      a. Style K (plaster)
      b. Style DW (gypsum board)
      c. Style M (Masonry)
      d. Style "Fire Rated" where required.

2.7 EXPANSION LOOPS

A. Manufactured assembly consisting of inlet and outlet elbow fittings, two sections of flexible metal hose and braid, and 180-degree return bend or center section of flexible hose. Flexible hose shall consist of corrugated metal inner hose and braided outer sheath.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

   Metraflex Inc., Metraloop series.
   Unisource Manufacturing, Inc., V series.

2.8 PIPE GUIDES

A. Where flexible connections are indicated on Drawings, provide Metraflex style IV, B-Line, or equal, pipe guides in locations recommended by manufacturer. Maximum spacing from flexible connection to first pipe guide is 4 pipe diameters, and maximum spacing from second pipe guide is 14 pipe diameters.

2.9 PIPE IDENTIFICATION

A. Identify each piping system and indicate the direction of flow by means of Seton, Inc., Marking Services Inc., Reef Industries, Inc., or equal, pre-tensioned, coiled semi-rigid plastic pipe labels formed to circumference of pipe, requiring no fasteners or adhesive for attachment to pipe.

B. The legend and flow arrow shall conform to ASME A13.1.

2.10 INSULATION WORK

A. General:
   1. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
   2. Adhesives and sealants shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
   3. The term "piping" used herein includes pipe, air separators, valves, strainers and fittings.
4. Apply insulating cement to fittings, valves and strainers and trowel smooth to the thickness of adjacent covering. Cover with jacket to match piping. Extend covering on valves up to the bonnet. Leave strainer cleanout plugs accessible.
5. Provide pre-formed PVC valve and fitting covers for indoor piping.
6. Provide factory-fabricated aluminum valve and fitting covers for outdoor piping.
7. Provide Calcium Silicate rigid insulation and sheet metal sleeve, 18 inch minimum length at each pipe hanger. Seal ends of insulation to make vapor tight with jacket.
8. Urethane insulation will not be allowed above ground or on hot water piping.
9. Test insulation, jackets, and lap-seal adhesives as a composite product and confirm flame spread of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with UL723, ASTM E84, or NFPA 255.
10. Clean thoroughly, test and have approved, all piping and equipment before installing insulation and/or covering.
11. Repair all damage to existing pipe and duct insulation whether or not caused during the work of this contract, to match existing adjacent insulation for thickness and finish, but conforming to flame spread and smoke ratings specified above.

B. Insulation of Piping:
1. Exposed insulated piping within the building shall have a Zeston 2000 25/50, Proto Lo-Smoke, or equal, PVC jacket and fitting cover installed over the insulation, applied per manufacturer’s instructions. Verify suitability with manufacturer of insulation. Insulation with pre-applied polymer jacket may be substituted at Contractor’s option.
2. Insulate indoor heating hot water piping with 3-1/2# per cubic foot minimum density fiberglass with factory applied ASJ-SSL jacket, 1-1/2 inches thick for pipes 1-1/4 inches and smaller, 2 inches thick for pipes 1-1/2 inches and larger.

C. Duct Insulation:
1. All duct insulation shall meet minimum R-value of R-8 at 3 inch thickness 3/4 pound per cubic foot density for ductwork installed outside the building insulation envelope. For ductwork installed within the building insulation envelope, duct insulation shall have a minimum R-value of R-4.2 at 2 inch thickness, 3/4 pound per cubic foot density.
2. General: Insulation applied to the exterior surface of ducts located in buildings shall have a flame spread of not more than 25 and a smoke-developed rating of not more than 50 when tested as a composite installation including insulation, facing materials, tapes and adhesives as normally applied. Material exposed within ducts or plenum shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50.
3. Wrap all unlined concealed supply and return ducts with fiberglass duct wrap, manufactured as a blanket of glass fibers factory laminated to a reinforced foil/kraft vapor retarding facing. Provide 2 inch stapling and taping flange. Wrap insulation entirely around duct and secure with outward clinching staples on 6 inch centers. Provide mechanical fasteners at maximum 18 inch centers for all bottoms of duct which are greater than 24 inches. Lap all insulation joints 3” minimum. Insulateducts installed tight against other work before hanging in place. Seal all seams, both longitudinal and transverse, and all staple and mechanical fastener penetrations of facing with scrim backed foil tape or recommended sealant, to provide a vapor tight installation.
4. Provide internal duct lining in accordance with specification section 23 80 00.

PART 3 EXECUTION

3.1 MECHANICAL DEMOLITION

A. Refer to Division 01 Sections “Cutting and Patching” and “Selective Demolition” for general demolition requirements and procedures.
B. Disconnect, dismantle and remove mechanical systems, equipment, and components indicated to be removed. Coordinate with all other trades.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping to remain with same or compatible piping material. Refrigerant system must be evacuated per EPA requirements.
   3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and cap remaining ducts with same or compatible ductwork material.
   4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
   5. Equipment to Be Removed: Drain down and cap remaining services and remove equipment.
   6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 ELECTRICAL REQUIREMENTS

A. Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the Mechanical Work with the Electrical Work to comply.

B. Furnish necessary control diagrams and instructions for the controls. Before permitting operation of any equipment which is furnished, installed, or modified under this Section, review all associated electrical work, including overload protection devices, and assume complete responsibility for the correctness of the electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers' Association. All equipment and connections exposed to the weather shall be NEMA IIIR with factory-wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.

C. All line voltage and low voltage wiring and conduit associated with the Temperature Control System are included in this Section. Wiring and conduit shall comply with Division 26.

3.3 PIPING SYSTEM REQUIREMENTS

A. Drawing plans, schematic and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

3.4 PRIMING AND PAINTING

A. Perform all priming and painting on the equipment and materials as specified herein.
B. Priming:
   1. Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed. Black steel pipe exposed to the weather shall be painted one coat of Rust-Oleum #1069 primer for black steel piping or Rust-Oleum #5260, Kelly Moore, or equal, primer for galvanized piping.
   2. Metal surfaces of items to be jacketed or insulated except ductwork and piping shall be given two coats of primer unless furnished with equivalent factory finish. Items to be primed shall be properly cleaned by effective means free of rust, dirt, scale, grease and other deleterious matter and then primed with the best available grade of zinc rich primer. After erection or installation, all primed surfaces shall be properly cleaned of any foreign or deleterious matter that might impair proper bonding of subsequent paint coatings. Any abrasion or other damage to the shop or field prime coat shall be properly repaired and touched up with the same material used for the original priming.
   3. Where equipment is provided with nameplate data, the nameplate should be masked off prior to painting. When painting is completed, remove masking material.

C. See Painting Section for detailed requirements.

3.5 INSTALLATION OF VALVES

A. General:
   1. Valves shall be full line size unless indicated otherwise on Drawings.
   2. Install horizontal valves with valve stem above horizontal, except butterfly valves.
   3. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
   4. Locate valves for easy access and provide separate support where necessary.
   5. Install valves in position to allow full stem movement.
   6. Install exposed polished or enameled connections with special care showing no tool marks or exposed threads.
   7. Butterfly valves conforming to the paragraph "Butterfly Valves" may be used in lieu of globe valves for locations above grade.
   8. Ball valves conforming to the paragraph "Ball Valves" may be used for locations above grade for services 2-1/2 inches and smaller.
   9. Valves 2-1/2 inches and smaller (except ball valves) in nonferrous water piping systems may be solder joint type with bronze body and trim.
   10. Provide ball or globe valves on inlet and outlet of each pump.

B. Calibrated Balancing Valves: Install calibrated balancing valves per manufacturers' recommendations, including requirements for straight pipe lengths at valve inlet and outlet.

C. Valve Adjustment: Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.6 INSTALLATION OF PIPING AND DUCT SYSTEMS

A. General:
   1. All piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.
   2. Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.
   3. Install piping to permit application of insulation and to allow valve servicing.
4. Where piping, conduit, or ductwork is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.

5. Horizontal runs of pipes, conduits, or ductwork suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.

6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.

7. At the time of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, all duct and other related air distribution component opening shall be covered with tape, plastic, sheet metal, or other methods acceptable to the enforcing agency.

8. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.

9. Pipe the discharge of each relief valve, air vent, backflow preventer, and similar device to floor sink or drain.

10. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.

11. Install horizontal valves with valve stem above horizontal.

12. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.

13. Verify final equipment locations for roughing-in.

14. Where piping is installed in walls within one inch of the face of stud, provide a 16 gauge sheet metal shield plate on the face of the stud. The shield plate shall extend a minimum of 1-1/2 inches beyond the outside diameter of the pipe.

B. Expansion Loops:
   1. Install expansion loops where piping crosses building expansion or seismic joints, between buildings, between buildings and canopies, and as indicated on Drawings.
   2. Install expansion loops of sizes matching sizes of connected piping.
   3. Install grooved-joint expansion joints to grooved-end steel piping.
   4. Materials of construction and end fitting type shall be consistent with pipe material and type of gas or liquid conveyed by the piping system in which expansion loop is installed.

C. Sleeves:
   1. Install Adjus-to-Crete, Pipeline Seal and Insulator, or equal, pipe sleeves of sufficient size to allow for free motion of pipe, 24 gauge galvanized steel. The space between pipe and sleeves through floor slabs on ground, through outside walls above or below grade, through roof, and other locations as directed shall be caulked with oakum and mastic and made watertight. The space between pipe and sleeve and between sleeve and slab or wall shall be sealed watertight.

   2. At Contractor’s option, Link-Seal, Metraflex Metraseal, or equal, casing seals may be used in lieu of caulking. Wrap pipes through slabs on grade with 1 inch thick fiberglass insulation to completely isolate the pipe from the concrete.

D. Floor, Wall, and Ceiling Plates:
   1. Fit all pipes with or without insulation passing through walls, floors, or ceilings, and all hanger rods penetrating finished ceilings with chrome-plated or stainless escutcheon plates.

E. Firestopping:
   1. Pack the annular space between the pipe sleeves and the pipe and between duct openings and ducts through all floors and walls with UL listed fire stop, and sealed at the ends. All pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.
a. Install fire caulking behind mechanical services installed within fire rated walls, to maintain continuous rating of wall construction.

2. Provide SpecSeal Systems UL fire rated sleeve/coupling penetrators for each pipe penetration or fixture opening passing through floors, walls, partitions or floor/ceiling assemblies. All Penetrators shall comply with UL Fire Resistance Directory (Latest Edition), and in accordance with CBC requirements.

3. Sleeve penetrators shall have a built-in anchor ring for waterproofing and anchoring into concrete pours or use the special fit cored hole penetrator for cored holes.

4. Copper and steel piping shall have SpecSeal plugs on both sides of the penetrator to reduce noise and to provide waterproofing.

5. All above Firestopping systems to be installed in strict accordance with manufacturer's instructions.

6. Alternate firestopping systems are acceptable if approved equal. However, any deviation from the above specification requires the Contractor to be responsible for determining the suitability of the proposed products and their intended use, and the Contractor shall assume all risks and liabilities whatsoever in connection therewith.

F. Hangers and Supports:

1. General: Support all ductwork, equipment and piping so that it is firmly held in place by approved iron hangers and supports, and special hangers as required. All components shall support weight of ductwork, equipment and pipe, fluid, and pipe insulation based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Pipe attachments or hangers, of same size as pipe or tubing on which used, or nearest available. Rigidly fasten hose faucets, fixture stops, compressed air outlets, and similar items to the building construction. The Architect shall approve all hanger material before installation. Do not support piping or ductwork with plumbers' tape, wire rope, wood, or other makeshift devices. Where building structural members do not match piping and ductwork support spacing, provide all "bridging" support members as required firmly attached to building structural members in a fashion approved by the Structural Engineer.

   a. Materials, design, and type numbers for support of piping per Manufacturers' Standardization Society (MSS), Standard Practice (SP)-58.

   b. Materials and design for ductwork support shall be per SMACNA "HVAC Duct Construction Standards, Metal and Flexible."

2. All hanger components shall be provided by one manufacturer: B-Line, Grinnell, Uni-Strut, Badger, or equal.

3. Pipe Hanger and Support Spacing:

   a. Vertical piping support spacing: B-line #B3373 clamps attached to the pipe above each floor to rest on the floor. Provide with lead or Teflon liners on copper tubing. Provide additional support at base of cast iron risers and support at unsupported riser joints and horizontal offsets per 2007 Mason Industries Seismic Restraint Guidelines. Provide intermediate support for vertical piping, spaced at or within the following maximum limits.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Steel Fluid</th>
<th>Steel Vapor</th>
<th>Copper Fluid</th>
<th>Copper Vapor</th>
<th>CPVC &amp; PVC (Note 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 - 1&quot;</td>
<td>12</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>Base and Each Floor</td>
</tr>
<tr>
<td>1-1/4 - 2&quot;</td>
<td>12</td>
<td>Each Floor</td>
<td>10</td>
<td>6</td>
<td>Base and Each Floor</td>
</tr>
</tbody>
</table>

BASIC HVAC MATERIALS AND METHODS

23 00 50-15
Note 1: Provide mid-story guides.

Note 2: For PVC piping, provide for expansion every 30 feet per IAPMO installation standard.

b. Vertical cast iron piping support spacing: Base and each floor not to exceed 15 feet.

c. Horizontal piping, hanger and support spacing: Locate hangers and supports at each change of direction, within one foot of elbow, and spaced at or within following maximum limits.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Steel Fluid</th>
<th>Steel Vapor</th>
<th>Copper Fluid</th>
<th>Copper Vapor</th>
<th>CPVC &amp; PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 - 1&quot;</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>1-1/4 - 2&quot;</td>
<td>7</td>
<td>10</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>2-1/2 - 3&quot;</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Over 4&quot;</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

d. Horizontal cast iron piping support spacing:
   1) Support piping at every other joint for piping length of less than 4 feet.
   2) For piping longer than 4 feet, provide support on each side of the coupling, within 18 inches of each joint.
   3) Hanger shall not be installed on the coupling.
   4) Provide support at each horizontal branch connection.
   5) Provide sway brace at 40 foot maximum spacing for all suspended pipe with no-hub joints, except where a lesser spacing is indicated in the 2007 Mason Industries Seismic Restraint Guidelines. Provide a brace on each side of a change in direction of 90 degrees or more. Brace riser joints at each floor and at 15 foot maximum intervals.

4. Suspended Piping:
   a. Individually suspended piping: B-Line B3690 J-Hanger or B3100 Clevis, complete with threaded rod, or equal. All hangers on supply and return piping handling heating hot water or steam shall have a swing connector at point of support.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Rod Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and Smaller</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; to 3-1/2&quot;</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>4&quot; to 5&quot;</td>
<td>5/8&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>3/4&quot;</td>
</tr>
</tbody>
</table>

b. Trapeze Suspension: B-Line 1-5/8 inch width channel in accordance with manufacturers' published load ratings. No deflection to exceed 1/180 of a span.

c. Trapeze Supporting Rods: Shall have a safety factor of five; securely anchor to building structure.

d. Pipe Clamps and Straps: B-Line B2000, B2400; isolate copper pipe with two thicknesses of 2 inches wide 10-mil polyvinyl tape. Where used for seismic support systems, provide B-Line B2400 series pipe straps.

e. Above Roof: H frame made from Uni-Strut hot-dipped galvanized 1-5/8 inch single or double channel with P-2072A or P-2073A foot secured to roof and surrounded with waterproof roofed-in sleeper. Secure to sleeper with lag screws, and secure sleeper to blocking under roof.

f. Steel Connectors: Beam clamps with retainers.

5. Duct Hanger and Support Spacing: Conform to Requirements of CMC and SMACNA "HVAC Duct Construction Standards, Metal and Flexible."

6. Support to Structure:
Steel Structure: Provide and install additional steel bracing as required to suit structure. Provide through bolts with length to suit requirements of the structural components. Burning or welding on any structural member may only be done if approved by the Architect.

7. Rubber Neoprene Pipe Isolators:
   a. Pipe isolators shall comprise an internal rubber or neoprene material that isolates pipe from hanger and structure. Install at all piping located in acoustical walls. Refer to Architectural Drawings for location of acoustical walls.
   b. Isolation material shall be either a rubber or neoprene material that prevents contact between the pipe and the structure. The rubber shall have between a 45 to 55 durometer rating and a minimum thickness of 1/2 inch.
   c. Acceptable Suppliers:
      1) Vertical runs: Acousto-Plumb or equal.
      2) Horizontal runs: B-Line, Vibraclamp; Acousto-Plumb or equal.

8. Provide rigid insulation and a 12 inch long, 18 gauge galvanized sheet iron shield between the covering and the hanger whenever hangers are installed on the outside of the pipe covering.

9. Insulate copper tubing from ferrous materials and hangers with two thicknesses of 3 inch wide, 10 mil polyvinyl tape wrapped around pipe.

10. Provide a support or hanger close to each change of direction of pipe either horizontal or vertical and as near as possible to concentrated loads.

11. Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power actuated inserts will not be allowed.

12. On chilled or combination hot and chilled water or refrigerant pipes, install the hangers on the outside of the pipe covering and not in contact with the pipe. Provide rigid insulation and a 12 inch long, 18 gauge galvanized sheet iron shield between the covering and the hanger whenever hangers are installed on the outside of the pipe covering.

3.7 PIPE JOINTS AND CONNECTIONS

A. General:
   1. Cutting: Cut pipe and tubing square, remove rough edges or burrs. Bevel plain ends of steel pipe.
   2. Remove scale, slag, dirt and debris from inside and outside of pipe before assembly.
   3. Boss or saddle type fittings or mechanically extracted tube joints will not be allowed.

B. Threaded Pipe: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply thread compound to external pipe threads: Rectorseal No. 5, Permatex No. 1, or equal.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

C. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for type of water conveyed by pipe. Join flanges with gasket and bolts according to ASME B31.9.

D. Copper Pipe and Tubing: All joints shall be brazed according to ASME Section IX, Welding and Brazing Qualifications, except pneumatic control piping, and hydronic piping having grooved-end fittings and couplings.

E. Welded Pipe:
3.8 UNIONs AND FLANGES

A. Install Epco, Nibco, or equal, dielectric unions or flanges at points of connection between copper or brass piping or material and steel or cast iron pipe or material except in drain piping. Bushings or couplings shall not be used.

B. Install unions in piping NPS 2" and smaller 3 or flanges in piping NPS 2-1/2" and larger whether shown or not at each connection to all equipment and tanks, and at all connections to all automatic valves, such as temperature control valves.

C. Locate the unions for easy removal of the equipment, tank, or valve.

D. Do not install unions or flanges in refrigerant piping systems.

3.9 ACCESS DOOR

A. Furnish and install access doors wherever required whether shown or not for easy maintenance of mechanical systems; for example, at concealed valves, strainers, traps, cleanouts, dampers, motors, controls, operating equipment, etc. Access doors shall provide for complete removal and replacement of equipment.

3.10 PIPE IDENTIFICATION

A. Provide temporary identification of each pipe installed, at the time of installation. Temporary identification shall be removed and replaced with permanent identification as part of the work.

B. Apply the legend and flow arrow at all valve locations; at all points where the piping enters or leaves a wall, partition, cluster of piping or similar obstruction, at each change of direction, and at approximately 20'-0" intervals on pipe runs. Variations or changes in locations and spacing may be made with the approval of the Architect. There shall be at least one marking in each room. Markings shall be located for maximum visibility from expected personnel approach.

C. Wherever two or more pipes run parallel, the markings shall be supplied in the same relative location on each.

D. Each valve on non-potable water piping shall be labeled with a metal tag stamped "DANGER -- NON-POTABLE WATER" in 1/4 inch high letters.

E. Apply the markings after painting and cleaning of piping and insulation is completed.

3.11 EXPANSION ANCHORS IN HARDENED CONCRETE

A. Refer to Structural Drawings.

B. Qualification Tests: The specific anchor shall have a current ICC-ES report and evaluated in cracked concrete in accordance with Acceptance Criteria AC193. If the specific anchor satisfies
cyclic testing requirements per Acceptance Criteria AC01, Section 5.6, the full allowable shear and tension loads listed in the current ICC-ES report and manufacturer's recommendations for the specific anchor may be used. Otherwise, the design shear and tension loads shall not be more than 80% of the listed allowable shear and tension loads for the specific anchor.

C. Installation: The anchors must be installed in accordance with the requirements given in ICC Research Committee Recommendations for the specific anchor.

D. Testing: Fifty percent of the anchors shall be load-tested on each job to twice the allowable capacity in tension, except that if the design load is less than 75 pounds; only one anchor in ten need be tested. If any anchor fails, all anchors must be tested. The load test shall be performed in the presence of a special inspector.

E. The load may be applied by any method that will effectively measure the tension in the anchor, such as direct pull with a hydraulic jack, a torque wrench calibrated using the specific anchor or calibrated spring-loading devices. Anchors in which the torque is used to expand the anchor without applying tension to the bolt may not be verified with a torque wrench.

3.12 TESTS AND ADJUSTMENTS

A. Test the installations in accordance with the following requirements and all applicable codes:
   1. Notify the Architect at least seven days in advance of any test.
   2. Inspector of Record should witness all tests of piping systems.
   3. All piping shall be tested at completion of roughing-in, or at other times as directed by the Architect.
   4. Furnish all necessary materials, test pumps, gases, instruments and labor required for testing.
   5. Isolate from the system all equipment that may be damaged by test pressure.
   6. Make connections to existing systems with flanged connection. During testing of the new work, provide a slip-in plate to restrict test pressure to new systems only. Remove plate and complete connection to existing system at completion of testing.
      a. Inspector of record shall witness final connection to system.

B. Test Schedule: No loss in pressure or visible leaks shall show after four hours at the pressures indicated.

<table>
<thead>
<tr>
<th>System Tested</th>
<th>Test Pressure PSI</th>
<th>Test With</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressed Air, Acetylene and Oxygen</td>
<td>200 lb.</td>
<td>Air &amp; Non-corrosive Leak</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test Fluid</td>
</tr>
<tr>
<td>Gases and Vacuum</td>
<td>100</td>
<td>Air &amp; Non-corrosive Leak</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test Fluid</td>
</tr>
<tr>
<td>All Hot, Chilled, Combination,</td>
<td>125</td>
<td>Water</td>
</tr>
<tr>
<td>Condenser Water Piping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 15 psi Steam Piping</td>
<td>150</td>
<td>Water</td>
</tr>
<tr>
<td>and All Steam Condensate Piping</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BASIC HVAC MATERIALS AND METHODS
23 00 50-19
Steam Piping Above 15 psi 300 Water
Fuel Oil 1-1/2 x WP & 20"
Distilled Deionized Water 50 Water

1. Test all steam piping with nominal pressure steam before insulating.
2. Flush distilled deionized water lines with distilled deionized water after test and approval.
3. Non-corrosive leak test fluid shall be suitable for use with the piping material specified, and with the type of gas conveyed by the piping system.

C. Perform operational tests under simulated or actual service conditions, including one test of complete plumbing installation with all fixtures and other appliances connected, and one test of complete installation of 48 hours each for heating and cooling with all equipment connected and operating.

D. Should any material or work fail in any of these tests, it shall be immediately removed and replaced for new material, and portion of the work replaced shall again be tested by Contractor at his own expense.

E. Lubricate each item of equipment, including motors, before operation.

3.13 OPERATION OF SYSTEMS

A. Do not operate any mechanical equipment for any purpose, temporary or permanent, until all of the following has been completed:
   1. Complete all requirements listed under "Check, Test and Start Requirements."
   2. Ductwork and piping has been properly cleaned. Piping systems shall be flushed and treated prior to operation.
   3. Filters, strainers etc. are in place.
   4. Bearings have been lubricated, and alignment of rotating equipment has been checked.
   5. Equipment has been run under observation, and is operating in a satisfactory manner.

B. Provide test and balance agency with one set of Contract Drawings, Specifications, Addenda, Change orders issued, applicable shop drawings and submittals and temperature control drawings.

C. Operate every fire damper, smoke damper, combination smoke and fire damper under normal operating conditions. Activate smoke detectors as required to operate the damper, stage fan, etc. Provide written confirmation that all systems operate in a satisfactory manner.

3.14 TEMPORARY HEAT

A. The General Contractor will provide for all temporary heat at such times as may be required or directed by the Architect and pay all fuel and energy costs incurred.

B. Temporary heating facilities proposed for use by the Contractor will be subject to review of the Architect. Prior to use of any equipment for temporary heat, install temporary filters on all return air inlets, to preclude dust and construction debris from entering the duct system. In addition, install filters in air handling units, and replace at the completion of temporary operation.

C. Filters used for temporary operation of systems shall be as specified for permanent filters specified herein.
D. Comply with Check, Test and Start Requirements for start-up of equipment prior to operation for temporary heat.

E. Contractor shall complete the permanent heating system as soon as possible, thereby making it available for temporary heat. When available, the system may be used as required at the direction of the Architect after systems are properly prepared for use as specified elsewhere. Contractor shall then be responsible for operating the system during periods required and the General Contractor shall pay the fuel and energy costs incurred. Operation of the heating system prior to the filing of "notice of completion" shall not change the Guarantee provisions in any way.

3.15 CHECK, TEST AND START REQUIREMENTS

A. An authorized representative of the equipment manufacturer shall perform check, test and start of each piece of mechanical equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the check test and start of the equipment.
1. As part of the submittal process, provide a copy of each manufacturer's printed startup form to be used.
2. Some items of specified equipment may require that check, test and start of equipment must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
3. Provide all personnel, test instruments, and equipment to properly perform the check, test and start work.
4. When work has been completed, provide copies of reports for review, prior to final observation of work.

B. Provide copies of the completed check, test and start report of each item of equipment, bound with the Operation and Maintenance Manual.

C. Upon completion of the work, provide a schedule of planned maintenance for each piece of equipment. Indicate frequency of service, recommended spare parts (including filters and lubricants), and methods for adjustment and alignment of all equipment components. Provide a copy of the schedule with each Operation and Maintenance Manual. Provide a copy of certification from the Owner's representative indicating that they have been properly instructed in maintenance requirements for the equipment installed.

3.16 PRELIMINARY OPERATIONAL REQUIREMENTS AND TESTS

A. Prior to observation to determine final acceptance, put HVAC, plumbing, and fire protection systems into service and check that work required for that purpose has been done, including but not limited to the following condensed check list. Provide indexed report to tabulating the results of all work.
1. All equipment has been started, checked, lubricated and adjusted in accordance with the manufacturer's recommendations, including modulating power exhausts if present.
2. Correct rotation of motors and ratings of overload heaters are verified.
3. Specified filters are installed and spare filters have been turned over to Owner.
4. All manufacturers' certificates of start-up specified have been delivered to the Owner.
5. All equipment has been cleaned, and damaged painted finishes touched up.
6. Damaged fins on heat exchangers have been combed out.
7. Missing or damaged parts have been replaced.
8. Flushing and chemical treatment of piping systems has been completed and water treatment equipment, where specified, is in operation.

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9. Equipment labels, pipe marker labels, ceiling markers and valve tags are installed.
10. Valve tag schedules, corrected control diagrams, sequence of operation lists and start-stop
    instructions have been posted.
11. Preliminary test and balance work is complete, and reports have been forwarded for review.
12. Automatic control set points are as designated and performance of controls checks out to
    agree with the sequence of operation.
13. Operation and Maintenance Manuals have been delivered and instructions to the operating
    personnel have been made.

B. Prior to the observation to determine final acceptance, operate all mechanical systems as
required to demonstrate that the installation and performance of these systems conform to the
requirements of these specifications.
1. Operate and test all mechanical equipment and systems for a period of at least five
   consecutive 8 hour days to demonstrate the satisfactory overall operation of the project as a
   complete unit.
2. Include operation of heating and air conditioning equipment and systems for a period of not
   less than two 8 hour days at not less than 90 percent of full specified heating and cooling
   capacities in tests.
3. Commence tests after preliminary balancing and adjustments to equipment have been
   checked. Immediately before starting tests, install air filters and lubricate all running
   equipment. Notify the Architect at least seven calendar days in advance of starting the
   above tests.
4. During the test period, make final adjustments and balancing of equipment, systems
   controls, and circuits so that all are placed in first class operating condition.
5. Where Utility District rebates are applicable, demonstrate that the systems meet the rebate
   program requirements.

C. Before handing over the system to Owner replace all filters with complete new set of filters.

D. Review of Contractor’s Tests:
1. All tests made by the Contractor or manufacturers’ representatives are subject to
   observation and review by the Owner. Provide timely notice prior to start of each test, in
   order to allow for observation of testing. Upon the completion of all tests, provide a letter to
   confirm that all testing has been successful.

E. Test Logs:
1. Maintain test logs listing the tests on all mechanical systems showing dates, items tested,
   inspectors’ names, remarks on success or failure of the tests.

F. Preliminary Operation:
1. The Owner reserves the right to operate portions of the mechanical system on a preliminary
   basis without voiding the guarantee.

G. Operational Tests:
1. Before operational tests are performed, demonstrate that all systems and components are
   complete and fully charged with operating fluid and lubricants.
2. Systems shall be operable and capable of maintaining continuous uninterrupted operation
   during the operating and demonstration period. After all systems have been completely
   installed, connections made, and tests completed, operate the systems continuously for a
   period of five working days during the hours of a normal working day.
3. This period of continuous systems operation may be coordinated with the removal of Volatile
   Organic Compounds (VOCs) from the building prior to occupancy should the Owner decide
   to implement such a program.
4. Control systems shall be completely operable with settings properly calibrated and adjusted.
5. Rotating equipment shall be in dynamic balance and alignment.
6. If the system fails to operate continuously during the test period, the deficiencies shall be corrected and the entire test repeated.

3.17 CERTIFICATES OF INSTALLATION

A. Contractor shall complete applicable “Certificates of Installation” forms contained in the California Building Energy Efficiency Standards and submit to the authorities having jurisdiction for approval and issuance of final occupancy permit, as described in the California Energy Code.

3.18 ACCEPTANCE REQUIREMENTS

A. Contractor shall complete the applicable Acceptance Requirements for Code Compliance contained in the California Building Energy Efficiency Standards. Refer to forms MCH-01-E on Drawings for systems having Acceptance testing requirements. Contractor shall perform Acceptance tests and shall complete the appropriate “Certificates of Acceptance” and submit certificates to the authorities having jurisdiction for approval and issuance of final occupancy permit.
   1. Covered Processes: In addition to systems listed in MCH-01-E on Drawings, complete Acceptance Requirements for the following systems, if applicable to Project:
      a. Parking garage ventilation systems.
      b. Compressed air systems.
      c. Type 1 Kitchen exhaust systems.

3.19 DEMONSTRATION AND TRAINING

A. An authorized representative of the equipment manufacturer shall train Owner-designated personnel in maintenance and adjustment of equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the Owner training for the equipment installed.
   1. As part of the submittal process, provide a training agenda outlining major topics and time allowed for each topic.
   2. Some items of specified equipment require that training must be performed by the manufacturer, using manufacturer’s employees. See specific equipment Articles in these Specifications for this requirement.
   3. Contractor shall provide three copies of certification by Contractor that training has been completed, signed by Owner’s representative, for inclusion in Operation and Maintenance Manual. Certificates shall include:
      a. Listing of Owner-designated personnel completing training, by name and title.
      b. Name and title of training instructor.
      c. Date(s) of training.
      d. List of topics covered in training sessions.
   4. Refer to specific equipment Articles for minimum training period duration for each piece of equipment.

END OF SECTION
SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

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. Balancing Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume systems.
   2. Balancing Hydronic Piping Systems:
      a. Variable-flow hydronic systems.
      b. Primary-secondary hydronic systems.

1.3 REFERENCES

A. Associated Air Balance Council (AABC)

B. National Environmental Balancing Bureau (NEBB)

1.4 DEFINITIONS

A. The intent of this Section is to use the standards pertaining to the TAB specialist engaged to perform the Work of this Contract, with additional requirements specified in this Section. Contract requirements take precedence over corresponding AABC or NEBB standards requirements. Differences in terminology between the Specifications and the specified TAB organization standards do not relieve the TAB entity engaged to perform the Work of this Contract of responsibility from completing the Work as described in the Specifications.

B. Similar Terms: The following table is provided for clarification only:

<table>
<thead>
<tr>
<th>Similar Terms</th>
<th>AABC Term</th>
<th>NEBB Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAB Specialist</td>
<td>TAB Agency</td>
<td>NEBB Certified Firm</td>
</tr>
</tbody>
</table>

TESTING, ADJUSTING, AND BALANCING FOR HVAC
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E. TAB: Testing, adjusting, and balancing.
F. TAB Organization: Body governing practices of TAB Specialists.
G. TAB Specialist: An entity engaged to perform TAB Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
   1. Provide list of similar projects completed by proposed TAB field supervisor.
   2. Provide copy of completed TAB report, approved by mechanical engineer of record for a completed project with similar system types and of similar complexity.

   1. Submit examinations report with qualifications data.


D. Interim Reports. Submit interim reports as specified in Part 3. Include list of system conditions requiring correction and problems not identified in Contract Documents examination report.

E. Certified TAB reports.
   1. Provide three printed copies of final TAB report. Provide one electronic file copy in PDF format.

F. Sample report forms.

G. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.
      a. Instruments to be used for testing and balancing shall have been calibrated within a period of one year, or less if so recommended by instrument manufacturer, and be checked for accuracy prior to start of work.
1.6 QUALITY ASSURANCE

A. Independent TAB Specialist Qualifications: Engage a TAB entity certified by AABC or NEBB.
   1. The certification shall be maintained for the entire duration of TAB work for this Project. If TAB specialist loses certification during this period, the Contractor shall immediately notify the Architect and submit another TAB specialist for approval. All work specified in this Section and in other related Sections performed by the TAB specialist shall be invalidated if the TAB specialist loses certification, and shall be performed by an approved successor.

B. To secure approval for the proposed TAB specialist, submit information certifying that the TAB specialist is either a first tier subcontractor engaged and paid by the Contractor, or is engaged and paid directly by the Owner. TAB specialist shall not be affiliated with any other entity participating in Work of this Contract, including design, furnishing equipment, or construction. In addition, submit evidence of the following:
   1. TAB Field Supervisor: Full-time employee of the TAB specialist and certified by AABC or NEBB.
      a. TAB field supervisor shall have minimum 10 years supervisory experience in TAB work.
   2. TAB Technician: Full-time employee of the TAB specialist and who is certified by AABC or NEBB as a TAB technician.
      a. TAB technician shall have minimum 4 years TAB field experience.

C. TAB Specialist engaged to perform TAB work in this Project shall be a business limited to and specializing in TAB work, or in TAB work and Commissioning.

D. TAB specialist engaged to perform TAB work shall not also perform commissioning activities on this Project.

E. Certified TAB field supervisor or certified TAB technician shall be present at the Project site at all times when TAB work is performed.
   1. TAB specialist shall maintain at the Project site a minimum ratio of one certified field supervisor or technician for each non-certified employee at times when TAB work is being performed.

F. Contractor shall notify Architect in writing within three days of receiving direction resulting in reduction of test and balance scope or other deviations from Contract Documents. Deviations from the TAB plan shall be approved in writing by the mechanical engineer of record for the Project.

G. TAB Standard:
   1. Perform TAB work in accordance with the requirements of the standard under which the TAB agencies' qualifications are approved unless Specifications contain different or more stringent requirements:
      a. AABC National Standards for Total System Balance, or
   2. All recommendations and suggested practices contained in the TAB standard are mandatory. Use provisions of the TAB standard, including checklists and report forms, to the extent to which they are applicable to this Project.
   3. Testing, adjusting, balancing procedures, and reporting required for this Project, and not covered by the TAB standard applicable to the TAB specialist engaged to perform the Work of this Contract, shall be submitted for approval by the design engineer.

H. TAB Conference: Meet with Architect and mechanical engineer on approval of the TAB strategies and procedures plan to develop a mutual understanding of the project requirements.
Require the participation of the TAB field supervisor. Provide seven days' advance notice of scheduled meeting time and location. TAB conference shall take place at location selected by Architect.

1. Agenda Items:
   b. The TAB plan.
   c. Coordination and cooperation of trades and subcontractors.
   d. Coordination of documentation and communication flow, including protocol for resolution tracking and documentation.

2. The requirement for TAB conference may be waived at the discretion of the mechanical engineer of record for the Project.

I. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.


K. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.7 WARRANTY

A. Provide workmanship and performance warranty applicable to TAB specialist engaged to perform Work of this Contract:
   1. AABC Performance Guarantee.
   2. NEBB Quality Assurance Program.

B. Refer to Division 01 Specifications for additional requirements.

1.8 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

C. Coordinate TAB work with work of other trades.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXAMINATION

A. Contract Documents Examination Report:
   1. TAB specialist shall review Contract Documents, including plans and specifications. Provide report listing conditions that would prevent the system(s) from operating in accordance with the sequence of operations specified, or would prevent accurate testing and balancing:
      a. Identify each condition requiring correction using equipment designation shown on Drawings. Provide room number, nearest building grid line intersection, or other information necessary to identify location of condition requiring correction.

TESTING, ADJUSTING, AND BALANCING FOR HVAC
b. Proposed corrective action necessary for proper system operation.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems’ output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report conditions requiring correction discovered before and during performance of TAB procedures.

P. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures. TAB plan shall be specific to Project and include the following:
   1. General description of each air system and sequence(s) of operation.
   2. Complete list of measurements to be performed.
   3. Complete list of measurement procedures. Specify types of instruments to be utilized and method of instrument application.

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4. Qualifications of personnel assigned to Project.
5. Single-line CAD drawings reflecting all test locations (terminal units, grilles, diffusers, traverse locations, etc.
6. Air terminal correction factors for the following:
   a. Air terminal configuration.
   b. Flow direction (supply or return/exhaust).
   c. Effective area of each size and type of air terminal.
   d. Air density.

B. Complete system-readiness checks and prepare reports. Verify the following:
   1. Permanent electrical-power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Equipment and duct access doors are securely closed.
   5. Balance, smoke, and fire dampers are open.
   6. Isolating and balancing valves are open and control valves are operational.
   7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
   2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 "Duct Insulation," Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation." Section 23 80 00 Heating, Ventilating, and Air Conditioning.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Test each system to verify building or space operating pressure, including all stages of economizer cycle. Maximum building pressure shall not exceed 0.03 inches of pressure.

C. Except as specifically indicated in this Specification, Pitot tube traverses shall be made of each duct to measure airflow. Pitot tubes, associated instruments, traverses, and techniques shall conform to ASHRAE Handbook, HVAC Applications, and ASHRAE Handbook, HVAC Systems and Equipment.
1. Use state-of-the-art instrumentation approved by TAB specialists governing agency.
2. Where ducts' design velocity and air quantity are both less than 1000 fpm/CFM, air quantity may be determined by measurements at terminals served.

D. Test holes shall be placed in straight duct, as far as possible downstream from elbow, bends, take-offs, and other turbulence-generating devices.

E. For variable-air-volume systems, develop a plan to simulate diversity.

F. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

G. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

I. Verify that motor starters are equipped with properly sized thermal protection.

J. Check dampers for proper position to achieve desired airflow path.

K. Check for airflow blockages.

L. Check condensate drains for proper connections and functioning.

M. Check for proper sealing of air-handling-unit components.

N. Verify that air duct system is sealed as specified in Section 23 80 00 "Heating, Ventilating, and Air Conditioning."

O. Provide for adjustments or modifications to fan and motor sheaves, belts, damper linkages, and other components as required to achieve specified air balance at no additional cost to Owner.

P. Automatically operated dampers shall be adjusted to operate as indicated in Contract Documents. Controls shall be checked for proper calibration.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
      a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow. Alternative methods shall be examined for determining total CFM, i.e., Pitot-tube traversing of branch ducts, coil or filter velocity profiles, prior to utilizing airflow values at terminal outlets and inlets.

   2. Measure fan static pressures as follows to determine actual static pressure:
      a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Check operation of relief air dampers. Measure total relief air quantity at each stage of normal, economizer, power exhaust, or power exhaust economizer operation, as applicable to installed equipment. Adjust relief air dampers to provide 100 percent relief in economizer mode. Ensure that relief dampers close completely upon unit shutdown.

C. Check operation of outside air dampers. Measure total outside air quantity at each stage of normal, economizer, power exhaust, or power exhaust economizer operation, as applicable to installed equipment. Adjust outside air dampers to provide 100 percent outside air in economizer mode. Ensure that outside air dampers close completely upon unit shutdown.

D. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure airflow of submain and branch ducts.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
   3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

E. Measure air outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading digital backflow compensating hood. Use outlet manufacturer’s written instructions and calculating factors only when direct-reading hood cannot be used due to physical obstruction or other limiting factors. Final report shall indicate where values listed have not been obtained by direct measurement.

F. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents, if included.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts. Terminal air velocity at five feet above finished floor shall not exceed 50 feet per minute in occupied air conditioned spaces.
G. Do not overpressurize ducts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Comply with applicable requirements for constant-volume air systems in addition to those listed below.

B. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

C. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
   a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data including optimum operating static control set point.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Complete air balance prior to hydronic systems balancing.

B. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed ranges given in article, Tolerances.

C. Prepare schematic diagrams of systems' "as-built" piping layouts.

D. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.9 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.10 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer's name, model number, and serial number.
   4. Efficiency rating.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter manufacturer's name, model number, size, type, and thermal-protection-element rating.
      a. Starter strip heater size, type, and rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.11 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:
   1. Entering- and leaving-water temperature.
   2. Water flow rate.
   3. Water pressure drop.
   4. Dry-bulb temperature of entering and leaving air.
   5. Wet-bulb temperature of entering and leaving air for cooling coils.
   6. Airflow.
   7. Air pressure drop.

3.12 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.
4. Check the condition of coils.
5. Check the operation of the drain pan and condensate-drain trap.
6. Check bearings and other lubricated parts for proper lubrication.
7. Report on the operating condition of the equipment and the results of the measurements taken. Report conditions requiring correction.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Conditions requiring correction noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.13 GENERAL PROCEDURES FOR PLUMBING SYSTEMS

A. Measure pressure drop across each backflow preventer assembly at design flows.

B. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner and comply with requirements in
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
   a. Monitor motor performance during procedures and do not operate motors in overload conditions.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within range given in article, Tolerances.
C. Set calibrated balancing valves, if installed, at calculated presets.

D. Measure flow at all stations and adjust, where necessary, to obtain first balance.
   1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

E. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

F. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
   1. Determine the balancing station with the highest percentage over indicated flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
   3. Record settings and mark balancing devices.

G. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

H. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

I. Check settings and operation of each safety valve. Record settings.

3.14 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 10 percent and minus 0 percent.
   2. Air Outlets and Inlets: Plus 5 percent and minus 5 percent.
   3. Multiple outlets within single room: Plus 5 percent and minus 0 percent for total airflow within room. Tolerance for individual outlets within a single room having multiple outlets shall be as for "Air Outlets and Inlets".
      a. Room shall be balanced to create pressure relationship (positive, negative, or neutral) with adjacent spaces as indicated on Drawings. Maintain airflow differentials between supply, return, and exhaust indicated on Drawings.
   4. Heating-Water Flow Rate: Plus or minus 10 percent.
   5. Cooling-Water Flow Rate: Plus or minus 10 percent.

B. Set plumbing systems water flow rates within plus or minus 10 percent.

3.15 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Interim Reports: Prepare periodic lists of conditions requiring correction and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.
3.16 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing field supervisor. Report shall be co-signed by the Contractor, attesting that he has reviewed the report, and the report has been found to be complete and accurate.
   2. The certification sheet shall be followed by sheet(s) listing items for which balancing objectives could not be achieved. Provide explanation for failure to achieve balancing objectives for each item listed.
   3. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB specialist.
   3. Project name.
   4. Project location.
   5. Project Performance Guaranty
   6. Architect's name and address.
   7. Engineer's name and address.
   8. Contractor's name and address.
   10. Signature of TAB supervisor who certifies the report.
   11. Table of Contents with the total number of pages defined for each section of the report.
       Number each page in the report.
   12. Summary of contents including the following:
       a. Indicated versus final performance.
       b. Notable characteristics of systems.
       c. Description of system operation sequence if it varies from the Contract Documents.
   13. Nomenclature sheets for each item of equipment.
   14. Data for terminal units, including manufacturer's name, type, size, and fittings.
   15. Test conditions for fans and pump performance forms including the following:
       a. Settings for outdoor-, return-, and exhaust-air dampers.
       b. Conditions of filters.
       c. Cooling coil, wet- and dry-bulb conditions.
       d. Fan drive settings including settings and percentage of maximum pitch diameter.
       e. Settings for supply-air, static-pressure controller.
       f. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
   1. Quantities of outdoor, supply, return, and exhaust airflows.
   2. Water flow rates.
   3. Duct, outlet, and inlet sizes.
   4. Pipe and valve sizes and locations.
5. Terminal units.

E. Air distribution outlets and inlets shall be shown on keyed plans with designation for each outlet and inlet matching designation used in Contract Documents and TAB test reports. Room numbers shall be included in keyed plans and test reports. Where multiple outlets and inlets are installed within a single room, a designation shall be assigned and listed for each outlet and inlet in addition to room number.

F. Test Reports – General:
1. All test reports containing air or liquid flow data shall record flow values prior to system adjustment in addition to required data listed for each test report.

G. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches, and bore.
   i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   j. Number, make, and size of belts.
   k. Number, type, and size of filters.
2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
   a. Total air flow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat-coil static-pressure differential in inches wg.
   g. Cooling-coil static-pressure differential in inches wg.
   h. Heating-coil static-pressure differential in inches wg.
   i. Outdoor airflow in cfm.
   j. Return airflow in cfm.
   k. Relief airflow in cfm.
   l. Outdoor-air damper position, normal and economizer, power exhaust, or power exhaust economizer modes, as applicable to installed equipment.
   m. Return-air damper position.
   n. Relief-air damper position, normal and economizer, power exhaust, or power exhaust economizer modes, as applicable to installed equipment.

H. Apparatus-Coil Test Reports:
1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
   f. Make and model number.
   g. Face area in sq. ft.
   h. Tube size in NPS.
   i. Tube and fin materials.
   j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Air flow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in gpm.
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
   1. Fan Data:
      a. System identification.
      b. Location.
      c. Make and type.
      d. Model number and size.
      e. Manufacturer’s serial number.
      f. Arrangement and class.
      g. Sheave make, size in inches, and bore.
      h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

   2. Motor Data:
      a. Motor make, and frame type and size.
      b. Horsepower and rpm.
      c. Volts, phase, and hertz.
      d. Full-load amperage and service factor.
      e. Sheave make, size in inches, and bore.
      f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
      g. Number, make, and size of belts.

   3. Test Data (Indicated and Actual Values):
      a. Total airflow rate in cfm.
      b. Total system static pressure in inches wg.
      c. Fan rpm.
      d. Discharge static pressure in inches wg.
      e. Suction static pressure in inches wg.

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
   1. Report Data:
      a. System and air-handling-unit number.
      b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:
   1. Unit Data:
      a. System and air-handling unit identification.
      b. Location and zone.
      c. Apparatus used for test.
      d. Area served.
      e. Make.
      f. Number from system diagram.
      g. Type and model number.
      h. Size.
      i. Effective area in sq. ft.
   2. Test Data (Indicated and Actual Values):
      a. Air flow rate in cfm.
      b. Air velocity in fpm.
      c. Preliminary air flow rate as needed in cfm.
      d. Preliminary velocity as needed in fpm.
      e. Final air flow rate in cfm.
      f. Final velocity in fpm.
      g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
   1. Unit Data:
      a. System and air-handling-unit identification.
      b. Location and zone.
      c. Room or riser served.
      d. Coil make and size.
      e. Flowmeter type.
   2. Test Data (Indicated and Actual Values):
      a. Air flow rate in cfm.
      b. Entering-water temperature in deg F.
      c. Leaving-water temperature in deg F.
      d. Water pressure drop in feet of head or psig.
      e. Entering-air temperature in deg F.
      f. Leaving-air temperature in deg F.

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Service.
      d. Make and size.
      e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):
a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

N. Instrument Calibration Reports:
   1. Report Data:
      a. Instrument type and make.
      b. Serial number.
      c. Application.
      d. Dates of use.
      e. Dates of calibration.

3.17 INSPECTIONS

A. Initial Inspection:
   1. After testing and balancing are complete, operate each system and randomly check
      measurements to verify that the system is operating according to the final test and balance
      readings documented in the final report.
   2. Check the following for each system:
      a. Measure airflow of at least 10 percent of air outlets.
      b. Measure water flow of at least 5 percent of terminals.
      c. Measure room temperature at each thermostat/temperature sensor. Compare the
         reading to the set point.
      d. Verify that balancing devices are marked with final balance position.
      e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:
   1. After initial inspection is complete and documentation by random checks verifies that testing
      and balancing are complete and accurately documented in the final report, request that a
      final inspection be made by Architect.
   2. The TAB specialist's test and balance engineer shall conduct the inspection in the presence
      of Architect.
   3. Architect shall randomly select measurements, documented in the final report, to be
      rechecked. Rechecking shall be limited to either 10 percent of the total measurements.
recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than 10 percent, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contact the TAB specialists' governing organization for remedial action by the governing organization under the workmanship and performance warranty. See article, Warranty.

3. If remedial action is not provided by the TAB specialists' governing organization in a timely manner, Owner may contract the services of another TAB specialist to complete the TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB specialists' final payment.

D. Prepare test and inspection reports.

3.18 ADDITIONAL TESTS

A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION
SECTION 23 09 00

BUILDING AUTOMATION SYSTEM

PART 1 GENERAL

1.1 CONDITIONS OF THE CONTRACT:
   A. The Conditions of the Contract (General, Supplementary, and other Conditions) and the General Requirements (Sections of Division 1) are hereby made a part of this Section.
   B. Division – 23 Basic HVAC Materials and Methods apply to work of this section.

1.2 WORK INCLUDED:
   A. Related Documents: The General Provisions of the Contract, including General, Supplementary, and Special Conditions, and Division 1 - General Requirements, apply to work specified in this section. Subcontractor must familiarize himself with the terms of the above documents.
   B. BAS Contractor-Division 230900:
      1. The Building Automation System (BAS) is to be furnished and installed by a factory authorized Andover distributor with factory warranted Andover parts. The designated distributor for this work is EMCOR Services Integrated Solutions (Contractor).
         a. All bidders must be building automation contractors in the business of installing Direct Digital Controls (DDC) for a minimum of 3 years.
         b. All bidders must have an office in the San Francisco Bay/Central Valley area.
         c. All bidders must be a channel partner for "Andover Controls".
         d. All bidders must have a trained staff of application engineers, who have been certified by Andover in Administration, Networking, Configuration, Programming and service of the automation system.
         e. All installers must have a factory-trained technician on-site at all times during installation of the DDC controls.
      2. Integration of the BAS system to the central BAS system shall be coordinated with the Facilities Manager at the work site.
   C. Scope of Work
      1. The BAS contractor shall review and study all HVAC drawings and the entire specification to familiarize him with the equipment and system operation and to verify the quantities and types of valves, operators, alarms, etc. to be provided.
      2. The Contractor shall furnish and install a complete building automation system including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification. Andover Controls Only to match existing campus system architecture. At a minimum, provide controls for the following:
         a. Air handling units.
         b. Exhaust and supply fans.
         c. VAVs w/reheat.
         d. Power wiring to DDC devices VAV and BAS panels by Division 26.
         e. Lighting.
      3. Provide services and manpower necessary for commissioning of system in coordination with the HVAC Contractor, Balancing Contractor and Owner's representative.
      4. All work performed under this section of the specifications will comply with all codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes,
the Contractor shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification will govern.

D. Training: Provide a minimum of (40) hours of on-site training for (3) system operators. The training will be hands-on type at the owner’s office. The training class will use the actual Operator’s Manual that will be submitted for this project. In addition to: projects over $100,000 will include (2) weeks of classroom training for one individual at the Manufacturer’s sponsored training courses.

E. System Description:
1. The Building Automation System (BAS) shall consist of PC-based workstation (existing) and microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions:
   a. For this project the system shall consist of the following (new) components:
      1) Ethernet-based Network Controller, refer to drawings for quantity and location.
      2) Stand-alone Digital Control Units.

F. Ethernet-based Network Controller: The BAS Contractor shall furnish (1) Ethernet-based network controller. This controller will connect directly to the campus LAN over the existing Ethernet system, refer to drawings for connection location.

G. Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control including air handlers, return/exhaust fans, and terminal unit control. Each SDCU will operate completely standalone, containing all of the I/O and programs to control its associated equipment; i2 series and Infinet II.

H. Work by Others
1. The BAS Contractor shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others’ work.
2. The BAS Contractor shall furnish all control valves, sensor wells, flow meters and other similar equipment for installation by the Mechanical Contractor
3. The Electrical Contractor shall provide:
   a. All power wiring to VAV Transformer Disconnects see floor plan for location, and BAS panels.

I. Code Compliance
1. All wiring shall conform to the National Electrical Code.
2. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.

J. Submittals
1. All shop drawings shall be prepared in AutoCAD software. In addition to the drawings, the Contractor shall furnish a diskette containing the identical information. Drawings shall be B size or larger.
2. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typical will be allowed where appropriate.
3. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification. Valve, damper and airflow station schedules shall indicate size, configuration, capacity and location of all equipment.

4. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software. Information shall be bound or in a three ring binder with an index and tabs.

5. Submit five (5) copies of submittal data and shop drawings to the Engineer and (one) copy to Facilities for review prior to ordering or fabrication of the equipment. The Contractor prior to submitting shall check all documents for accuracy.

6. The Engineer will make corrections, if required, and forward to Facilities prior to returning to the Contractor. The Contractor will then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully approved.

K. System Startup & Commissioning

1. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report will be submitted to the owner indicating that the installed system functions in accordance with the plans and specifications.

2. The BAS contractor shall commission and set in operating condition all major equipment and systems, such as the chilled water, hot water and all air handling systems, in the presence of the equipment manufacturer’s representatives, as applicable, and the Owner and Architect’s representatives.

3. The BAS Contractor shall provide all manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building. The BAS Contractor shall have a trained technician available on request during the balancing of the systems. The BAS Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and shall include all labor and materials in his contract.
L. Training
1. The BAS Contractor shall provide both on-site and classroom training to the Owner's representative and maintenance personnel per the following description:
   2. On-site training shall be per section 1.02 D and shall consists of "hands-on" instruction geared at the operation and maintenance of the systems. The curriculum shall include
      a. System Overview.
      c. System access.
      d. Software features overview.
      e. Changing setpoints and other attributes.
      f. Scheduling.
      g. Editing programmed variables.
      h. Displaying color graphics.
      i. Running reports.
      j. Workstation maintenance.
      k. Application programming.
      l. Operational sequences including start-up, shutdown, adjusting and balancing.
      m. Equipment maintenance.

M. Operating and Maintenance Manuals
1. The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation, and parts procurement for the entire BAS. This documentation shall include specific part numbers and software versions and dates. A complete list of recommended spare parts shall be included with the leadtime and expected frequency of use of each part clearly identified.
2. Following project completion and testing, the BAS contractor will submit as-built drawings reflecting the exact installation of the system. The as-built documentation shall also include a copy of all application software both in written form and on diskette.

N. Warranty: The BAS contractor shall warrant the system for 12 months after system acceptance and beneficial use by the owner. During the warranty period, the BAS contractor shall be responsible for all necessary revisions to the software as required to provide a complete and workable system consistent with the letter and intent of the Sequence of Operation section of the specification.
PART 2 PRODUCTS

2.1 SYSTEM ARCHITECTURE:

A. General: The Building Automation System (BAS) shall consist of Network Control Units (NCUs), a family of Standalone Digital Control Units (SDCUs), Input/Output Unit Modules (IOU Modules), Operator Workstations (OWs), and one File Server to support system configurations where more than one operator workstation is required. The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable, from a single ODBC-compliant database.

B. Level 1 Network Description: Level 1, the main backbone of the system, shall be an Ethernet LAN/WAN. Network Control Units, Operator Workstations, and the Central File Server shall connect directly to this network without the need for Gateway devices.

C. Level 2 Network Description
   1. Level 2 of the system shall consist of one or more field buses managed by the Network Control Units. The Level 2 field buses may consist of one or both of the following types:
      a. An RS485, token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs) per communication port for operation of HVAC equipment and lighting, or
      b. An RS485 field bus that supports up to 32 devices from a family of plug-in, IOU modules.
   2. These IOU modules may be mounted within the NCU enclosure or remotely mounted via a single, twisted, shielded pair of wires.

D. BAS: The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN), sharing a single file server. This enables workstations to manage a single LAN (or building), and/or the entire system with all devices being assured of being updated by and sharing the most current database. In the case of a single workstation system, the workstation shall contain the entire database – with no need for a separate file server.

E. Standard Network Support: All NCUs, Workstation(s) and File Server shall be capable of residing directly on the owner’s Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NCU’s, Workstation(s) and File Server shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner’s Information Systems Department as all devices utilize standard TCP/IP components.

F. System Expansion
   1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same Level 1 and Level 2 controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
   2. The BAS shall be expandable to include Security and Access Control functions at any time in the future with no additional workstations, front-end software or Level 1 controllers required. Standalone Digital Control Units or IOU modules shall be able to be added to the existing Level 1 controller’s field bus (es), to perform security and card access applications. In this way, an owner’s existing investment in wiring infrastructure may be leveraged and the cost and inconvenience of adding new field bus wiring will be minimized.
   3. Additionally, an integrated video badging option must be able to be included with no additional workstations required. This photo ID option must share the same database as the BAS in order to eliminate the need for updating multiple databases.
4. The system shall use the same application programming language for all levels: Operator Workstation, Network Control Unit, Remote Site Control Unit and Standalone Digital Control Unit. Furthermore, this single programming language shall be used for all applications: environmental control, card access control, intrusion detection and security, lighting control, leak detection / underground storage tank monitoring, and digital data communication interfaces to third party microprocessor-based devices.

G. Support for Open Systems Protocols
1. The BAS design must include solutions for the integration of the following "open systems" protocols: BACnet, LonTalk™, MODBUS and digital data communication to third party microprocessors such as chiller controllers, fire panels and variable frequency drives (VFDs).
2. The system shall also provide the ability to program custom ASCII communication drivers that will reside in the NCU, for communication to third party systems and devices. These drivers will provide real time monitoring and control of the third party systems.

2.2 NETWORK CONTROL UNITS (NCUs)

A. General
1. Network Control Units shall be microprocessor based, multi-tasking, multi-user, and employ a real time operating system. Each NCU control panel shall consist of modular hardware including power supply, CPU board, and input/output modules. A sufficient number of NCUs shall be supplied to fully meet the requirements of this specification and the attached point list.
2. NCUs for telephone dialup sites shall be of the same design as the Ethernet control units but without the plug-in Ethernet network interface card (NIC), i.e., NCUs, which include a NIC, shall be interchangeable whether used on a LAN/WAN or a dialup site.

B. Webserver Functionality
1. All NCUs on the Ethernet TCP/IP LAN/WAN shall be capable, out-of-the box, to be set up as a Web Server. The NCU shall have the ability to store HTML code and "serve" pages to a web browser. This provides the ability for any computing device utilizing a TCP/IP Ethernet connection and capable of running a standard Internet browser (Microsoft Internet Explorer™, Netscape Navigator™, etc.) to access real-time data from the entire BAS via any NCUs.
2. Graphics and text-based web pages shall be constructed using standard HTML code. The interface shall allow the user to choose any of the standard text or graphics-based HTML editors for page creation. It shall also allow the operator to generate custom graphical pages and forms.
3. The WEB server interface shall be capable of password security, including validation of the requesting PC's IP address. The WEB server interface shall allow the sharing of data or information between any controller, or process or network interface (BACnet, LonTalk and TCP/IP) that the BMS has knowledge of, regardless of where the point is connected on the BAS network or where it is acquired from.
4. The BAS network controller must act directly as the WEB server. It must directly generate the HTML code to the requesting user (i.e. WEB browser), eliminating the need for and reliance on any PC-based WEB server hardware or software. To simplify graphic image space allocation, HTML graphic images, if desired, shall be stored on any shared network device. The BAS WEB server shall have the ability to acquire any necessary graphics using standard pathing syntax within the HTML code mounted within the BAS WEB server. External WEB server hardware and software are not acceptable.

C. Hardware Specifications
1. Memory: A minimum of 32 MB of RAM shall be provided for NCUs and shall include a floating-point math co-processor.

D. Communication Ports: Each NCU shall provide communication to both the Workstation(s) and the field buses. In addition, each NCU must have at least 3 other communications ports that support a telephone modem, portable service tool, serial printer and connection to third party controllers such as a chiller control panel. On a LAN/WAN system the NCU shall be provided with a 10/100 baseT Mbps plug-in Ethernet TCP/IP network interface card (NIC).

E. Input/Output (I/O):
1. Each NCU shall support the addition of the following types of inputs and outputs:
   a. Digital Inputs for status/alarm contacts.
   b. Counter Inputs for summing pulses from meters.
   c. Thermistor inputs for measuring temperatures in space, ducts and thermowells.
   d. Analog inputs for pressure, humidity, flow and position measurements.
   e. Digital Outputs for on/off equipment control.
   f. Analog Outputs for valve and damper position control, and capacity control of primary equipment.

F. Modular Expandability: The system shall employ a modular I/O design to allow easy expansion. Input and output capacity is to be provided through plug-in modules of various types or DIN-mountable IOU modules. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.

G. Real Time Clock (RTC): Each NCU shall include a battery-backed, real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. In normal operation the system clock will be based on the frequency of the AC power. The system shall automatically correct for daylight savings time and leap years and be Year 2000 compliant.

H. Power Supply: The power supply for the NCUs shall be auto sensing, 120-220VAC, 60/50 Hz power, with a tolerance of +/- 20%. Line voltage below the operating range of the system shall be considered outages. The controller shall contain over voltage surge protection, and require no additional AC power signal conditioning. Optionally, if indicated on the drawings, the power supply shall accept an input voltage of (-48 VDC).

I. Automatic Restart After Power Failure: Upon restoration of power after an outage, the ECU shall automatically and without human intervention: update all monitored functions; resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

J. Battery backup: Each NCU with the standard 120-220VAC power supply shall include a programmable DC power backup system rated for a minimum of 72 hours of battery backup to maintain all volatile memory or, a minimum of 2 hours of full UPS including modem power. This power backup system shall be configurable such that at the end of a settable timeframe (such as
1 hour) of running on full UPS, the unit will shut off full UPS and switch to memory retention-only mode for the remainder of the battery power. The system shall allow the simple addition of more batteries to extend the above minimum battery backup times. Each NCU with a control transformer shall include a minimum of 7 days of power failure backup of RAM memory.

K. Software Specifications: User Programming Language: The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be English language-based and programmable by the user. The language shall be structured to allow for the easy configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, passwords, and histories. The language shall be self-documenting. Users shall be able to place comments anywhere in the body of a program. Program listings shall be configurable by the user in logical groupings.

L. Control Software:
   1. The NCU shall have the ability to perform the following pre-tested control algorithms:
      a. Proportional, Integral plus Derivative Control (PID).
      b. Self Tuning PID.
      c. Two Position Control.
      d. Digital Filter.
      e. Ratio Calculator.
      f. Equipment Cycling Protection.

M. Mathematical Functions: Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

N. Energy Management Applications:
   1. NCUs shall have the ability to perform any or all of the following energy management routines:
      a. Time of Day Scheduling.
      b. Calendar Based Scheduling.
      c. Holiday Scheduling.
      d. Temporary Schedule Overrides.
      e. Optimal Start.
      f. Optimal Stop.
      g. Night Setback Control.
      h. Enthalpy Switchover (Economizer).
      i. Peak Demand Limiting.
      j. Temperature Compensated Duty Cycling.
      k. CFM Tracking.
      l. Heating/Cooling Interlock.
      m. Hot/Cold Deck Reset.
      n. Free Cooling.
      o. Hot Water Reset.

O. History Logging: Each controller shall be capable of logging any system variable over user defined time intervals ranging from 1 second to 1440 minutes. Any system variables (inputs, outputs, math calculations, flags, etc.) can be logged in history. A maximum of 32767 values can be stored in each log. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logs can be automatic or manual. Logged data shall be
downloadable to the Operator Workstation for long term archiving based upon user-defined time intervals, or manual command.

P. Alarm Management: For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms will be tested each scan of the NCU and can result in the display of one or more alarm messages or reports.

Q. Up to 8 alarms can be configured for each point in the controller.

R. Messages and reports can be sent to a local terminal, to the front-end workstation(s), or via modem to a remote-computing device.

S. Alarms will be generated based on their priority. A minimum of 255 priority levels shall be provided: If communication with the Operator Workstation is temporarily interrupted, the alarm will be buffered in the NCU. When communications return, the alarm will be transmitted to the Operator Workstation if the point is still in the alarm condition.

T. Reporting: The NCU shall be able to generate user-definable reports to a locally connected printer or terminal. The reports shall contain any combination of text and system variables. Report templates shall be able to be created by users in a word processing environment. Reports can be displayed based on any logical condition or through a user command.

2.3 STANDALONE DIGITAL CONTROL UNITS (SDCUs)

A. General: Standalone Digital Control Units shall provide control of HVAC and lighting. Each controller shall have its own control programs and will continue to operate in the event of a failure or communication loss to its associated NCU.

B. Memory: Control programs shall be stored in battery backed-up RAM and EPROM. Each controller shall have a minimum of 128K bytes of user RAM memory and 128K bytes of EPROM.

C. Communication Ports: SDCUs shall provide a communication port to the field bus. In addition, a port shall be provided for connection of a portable service tool to support local commissioning and parameter changes with or without the NCU online. It shall be possible from a service port on any SDCU to view, enable/disable, and modify values of any point or program on any controller on the local field bus, any NCU or any SDCU on a different field bus.

D. Input/Output:
   1. Each SDCU shall support the addition of the following types of inputs and outputs:
      a. Digital Inputs for status/alarm contacts.
      b. Counter Inputs for summing pulses from meters.
      c. Thermistor Inputs for measuring temperatures in space, ducts and thermowells.
      d. Analog inputs for pressure, humidity, flow and position measurements.
      e. Digital Outputs for on/off equipment control.
      f. Analog Outputs for valve and damper position control, and capacity control of primary equipment.

E. Expandability: Input and output capacity shall be expandable through the use of plug-in modules. A minimum of two modules shall be added to the base SDCU before additional power is required.

F. Networking: Each SDCU will be able to exchange information on a peer-to-peer basis with other Standalone Digital Control Units during each field bus scan. Each SDCU shall be capable of storing and referencing global variables (on the LAN) with or without any workstations online.
Each SDCU shall be able to have its program viewed and/or enabled/disabled either locally through a portable service tool or through a workstation connected to an NCU.

G. Indicator Lamps: SDCUs will have as a minimum, LED indication of CPU status, and field bus status.

H. Real Time Clock (RTC): An SDCU shall have a real time clock in either hardware or software. The accuracy shall be within 10 seconds per day. The RTC shall provide the following information: time of day, day, month, year, and day of week. Each SDCU shall receive a signal, every hour, over the network from the NCU, which synchronizes all SDCU real time clocks.

I. Automatic Restart after Power Failure: Upon restoration of power, the SDCU shall automatically and without human intervention, update all monitored functions, resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

J. Battery Back Up: Each SDCU shall have at least 3 years of battery back up to maintain all volatile memory.

K. Alarm Management:
   1. For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms will be tested each scan of the SDCU and can result in the display of one or more alarm messages or reports.
   2. Up to 8 alarms can be configured for each point in the controller enabling the escalation of the alarm priority (urgency) based upon which alarm(s) is/are triggered.
   3. Alarm messages can be sent to a local terminal or modem connected to an NCU or to the Operator's Workstation(s).
   4. Alarms will be generated based on their priority. A minimum of 255 priority levels shall be provided.
   5. If communication with the NCU is temporarily interrupted, the alarm will be buffered in the SDCU. When communications return, the alarm will be transmitted to the NCU if the point is still in the alarm condition.

L. Air Handler Controllers (To be used on units with less than 40 points)
   1. AHU Controllers shall be capable of meeting the requirements of the sequence of operation found in the Execution portion of this specification and for future expansion.
   2. AHU Controllers shall support all the necessary point inputs and outputs as required by the sequence and operate in a standalone fashion.
   3. AHU Controllers shall be fully user programmable to allow for modification of the application software.
   4. An LCD display shall be optionally available for readout of point values and to allow operators to change setpoints and system parameters.
   5. A manual override switch shall be provided for all digital and analog outputs on the AHU Controller. The position of the switch shall be monitored in software and available for operator displays and alarm notification.

M. VAV Terminal Unit Controllers
   1. VAV Terminal Unit Controllers shall support, but not be limited to the control of the following configurations of VAV boxes to address current requirements as described in the Execution portion of this specification, and for future expansion:
      a. VAVR.
      b. Single Duct Cooling with Reheat (Hot Water).
   2. VAV Controllers to be Andover i2866-V, i2865-V with LED smart stats.
   3. VAV Controllers for single duct applications will come equipped with a built-in actuator for modulation of the air damper. The actuator shall have a minimum torque rating of 50 in.-lb,
and contain an override mechanism for manual positioning of the damper during startup and service.

4. VAV Controllers shall contain an integral velocity sensor accurate to +/- 5% of the full range of the box’s CFM rating.

5. Each controller shall perform the sequence of operation described in Part 3 of this specification, and have the capability for time of day scheduling, occupancy mode control, after hours operation, lighting control, alarming, and trending.

6. VAV Controllers shall be able to communicate with any other Standalone Digital Control Unit on the same field bus with or without communication to the NCU managing the field bus. Systems that fail to provide this (true peer-to-peer) capability will be limited to a maximum of 32 VAV controllers per field bus.

N. Display Controllers
1. Display controllers are standalone, touch screen based operator interfaces. The controller shall be designed for flush mounting in a finished space, with a minimum display size of 9 x 9 inches.

2. Software shall be user programmable allowing for custom graphical images that simulate floor plans, menus, equipment schematics along with associated real time point values coming from any NCU on the network.

3. The touch screen display shall contain a minimum of 64 possible touch cells that permit user interaction for changing screens, modifying setpoints or operating equipment.

4. Systems that do not offer a display controller as specified must provide a panel mounted computer with touch screen capability as an alternative.

2.4 OPERATOR WORKSTATION REQUIREMENTS (existing LAN System) Workstation and Server are not added to this project. However all controllers will be added to the existing Infinet and LAN system.

A. General.
1. The BAS workstation software shall be configurable as either a single workstation system (with a local database) or multi-workstation system where the database is located on a central file server. The client software on multi-workstation system shall access the file server database program via an Ethernet TCP/IP network running at either 10MBPS or 100MBPS.

2. New Workstation shall be:

<table>
<thead>
<tr>
<th>PROCESSOR</th>
<th>Intel® Core™ i5 Processor 680 with VT (3.60GHz, 4M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERATING SYSTEM</td>
<td>Windows 7 Professional</td>
</tr>
<tr>
<td>WARRANTY &amp; SERVICE</td>
<td>3 Year ProSupport and 3 Year NBD Onsite Service</td>
</tr>
<tr>
<td>SYSTEMS MANAGEMENT</td>
<td>Intel Core i7/i5 vPro Technology Enabled</td>
</tr>
<tr>
<td>MODE</td>
<td></td>
</tr>
<tr>
<td>MEMORY</td>
<td>4GB DDR3 Non-ECC SDRAM, 1333MHz, (2 DIMM)</td>
</tr>
<tr>
<td>HARD DRIVE</td>
<td>500GB 2.5 SATA 3.0Gb/s and 16MB DataBurst Cache™</td>
</tr>
<tr>
<td>OPTICAL DRIVE</td>
<td>16X DVD+/-RW SATA, Roxio Creator™ Cyberlink PowerDVD™</td>
</tr>
<tr>
<td>VIDEO CARD</td>
<td>Integrated Intel® Graphics Media Accelerator HD, DisplayPort/ VGA</td>
</tr>
<tr>
<td>MONITOR</td>
<td>Dell UltraSharp™ 2007FP 20in HAS Monitor, VGA/DVI</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>ENERGY SMART</td>
<td>Dell Energy Smart Enable (ESMART)</td>
</tr>
<tr>
<td>FILE SYSTEM</td>
<td>NTFS File System for all Operating Systems</td>
</tr>
<tr>
<td>SYSTEM DOCUMENTATION</td>
<td>Resource DVD contains Diagnostics and Driver for Dell OptiPlex System</td>
</tr>
<tr>
<td>KEYBOARD</td>
<td>Dell Multimedia Pro Keyboard, English</td>
</tr>
<tr>
<td>MOUSE</td>
<td>Dell MS111 USB Optical Mouse</td>
</tr>
</tbody>
</table>

*The application software shall be capable of communication to all Network Control Units and Standalone Digital Control Units, feature high-resolution color graphics, alarming, reporting, and be user configurable for all data collection and data presentation functions.

3. For multi-workstation systems, a minimum of 256 workstations shall be allowed on the Ethernet network along with the central file server. In this client/server configuration, any changes or additions made from one workstation will automatically appear on all other workstations without the requirement for manual copying of files. Multi-workstation systems with no central database will not be acceptable. Multi-workstation systems with distributed/tiered file servers and a central (master) database will be acceptable.
B. Workstation Software
   1. General Description:
      a. The software architecture must be object-oriented in design, a true 32-bit application suite utilizing Microsoft's OLE, COM, DCOM and ODBC technologies. These technologies make it easy to fully utilize the power of the operating system to share, among applications (and therefore to the users of those applications), the wealth of data available from the BAS.
      b. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long-term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.
      c. Programming of controllers shall be capable of being done either off-line or online from any operator workstation. All information will be available in graphic or text displays. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

C. System Database: The files server database engine must be Microsoft SQL Server (depending on Continuum version). This ODBC (Open Database Connectivity) compliant database engine allows for an owner to utilize "their" choice of database and due to its "open" architecture, allows an owner to write custom applications and/or reports which communicate directly with the database avoiding data transfer routines to update other applications. The system database shall contain all point configurations and programs in each of the controllers that have been assigned to the network. In addition, the database will contain all workstation files including alarm reports, text reports, historical data logs, schedules, and polling records.
   1. New Workstation shall be:

   | PRIMARY PROCESSOR | Intel® Xeon® E5620 2.4Ghz, 12M Cache, Turbo, HT, 1066MHz Max Mem |
   | MEMORY            | 8GB Memory (4x2GB), 1333MHz 1R LV UDIMMs for 1 Processor, Advanced ECC |
   | SYSTEMS MANAGEMENT MODE | Intel Core i7/i5 vPro Technology Enabled |
   | OPERATING SYSTEM  | Windows Server 2008 R2, Standard Edition,x64, Includes 5 CALS |
   | HARD DRIVE CONFIGURATION | RAID 1 for H700, PERC 6/i, H200 or SAS 6/iR Controllers |
   | INTERNAL CONTROLLER | PERC H200 Integrated RAID Controller |
   | HARD DRIVES       | 500GB 7.2K RPM SATA 2.5-in HotPlug Hard Drive |
   | MICROSOFT SQL SERVER | Microsoft®SQL Server™2008R2 Workgroup w5 CALs, OEM, NFI,w/Media |
   | NETWORK ADAPTER   | Broadcom 5709 Dual Port 1GbE NIC w/TOE iSCSI, PCIe-4 |
D. User Interface: The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user that has logged into the workstation software. This interface shall support the creation of "hot-spots" that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user’s "PC Desktop" – with all the links that a user needs to run other applications. This, along with the Windows NT user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.

E. User Security: The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 256 users to be configured per workstation. There shall be an inactivity timer adjustable in software that automatically logs off the current operator after the timer has expired.

F. Configuration Interface:
1. The workstation software shall use a familiar Windows Explorer*-style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a "network map" of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions. Object names shall not be required to be unique throughout the system. This allows consistency in point naming. For example, each VAV controller can have an input called Space Temperature and a setpoint called CFM Setpoint. The VAV controller name shall be unique such as VAV for LAB101. Systems requiring unique object names throughout the system will not be acceptable.

2. The configuration interface shall also include support for template objects. These template objects shall be used as building blocks for the creation of the BAS database. The types of template objects supported shall include all data point types (input, output, string variables, setpoints, etc.), alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of template object types shall be able to be set up as template subsystems and systems. The template system shall prompt for data entry if
necessary. The template system shall maintain a link to all "child" objects created by each template. If a user wishes to make a change to a template object, the software shall ask the user if he/she wants to update all of child objects with the change. This template system shall facilitate configuration and programming consistency and afford the user a fast and simple method to make global changes to the BAS.

G. Color Graphic Displays
1. The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse. Requirements of the color graphic subsystem include:
   a. SVGA, bit-mapped displays. The user shall have the ability to import AutoCAD generated picture files as background displays.
   b. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, ad graphs which can be "dropped" on a graphic through the use of a software configuration "wizard". These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.
   c. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, and text, blinking or changing from one display to another.
   d. Graphic panel objects shall be able to be configured with multiple "tabbed" pages allowing an operator to quickly view individual graphics of equipment, which make up a subsystem or system.
   e. Ability to link graphic displays through user-defined objects; alarm testing, or the result of a mathematical expression.
   f.Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.

H. Alarm Management
1. The software shall be capable of accepting alarms directly from controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.
2. Alarm management features shall include:
   a. A minimum of 255 alarm notification levels. Each notification level will establish a unique set of parameters for controlling alarm display, acknowledgment, keyboard annunciation, alarm printout and record keeping.
   b. Automatic logging in the database of the alarm message, point name, point value, connected controller, timestamp, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement)
   c. Automatic printing of the alarm information or alarm report to an alarm printer or report printer.
   d. Playing an audible beep or audio (wav) file on alarm initiation or return too normal.
   e. Sending an email or alphanumeric page to anyone listed in a workstation's email account address list on either the initial occurrence of an alarm and/or if the alarm is repeated because an operator has not acknowledged the alarm within a userconfigurable timeframe. The ability to utilize email and alphanumeric paging of alarms shall be a standard feature of the software integrated with the operating system's mail application interface (MAPI). No special software interfaces shall be required.
f. Individual alarms shall be able to be re-routed to a workstation or workstations at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.

g. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.

h. The font type and color, and background color for each alarm notification level as seen in the active alarm viewer shall be customizable to allow easy identification of certain alarm types or alarm states.

i. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.

I. Scheduling
   1. It shall be possible to configure and download from the workstation schedules for any of the controllers on the network.
   2. Time of day schedules shall be in a calendar style and shall be programmable for a minimum of one year in advance. Each standard day of the week and user-defined day types shall be able to be associated with a color so that when the schedule is viewed it is very easy, at-a-glance, to determine the schedule for a particular day even from the yearly view. To change the schedule for a particular day, a user shall simply click on the day and then click on the day type.
   3. Each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.
   4. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.

J. Programmer's Environment: The programmer's environment will include access to a superset of the same programming language supported in the controllers. Here the programmer will be able to configure application software off-line (if desired) for custom program development, write global control programs, system reports, wide area networking data collection routines, and custom alarm management software. On the same screen as the program editor, the programming environment shall include dockable debug and watch bars for program debugging and viewing updated values and point attributes during programming. In addition a wizard tool shall be available for loading programs from a library file in the program editor.

K. Saving/Reloading: The workstation software shall have an application to save and restore field controller memory files. This application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller: This allows offline debugging of control programs, for example, and then reloading of just the modified information

L. Data Logging: The workstation software shall have the capability to easily configure groups of data points with trend logs and display the trend log data. A group of data points shall be created by drag-and-drop method of the points into a folder. The trend log data shall be displayed through a simply menu selection. This data shall be able to be saved to file and/or printed.

M. Audit Trail: The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
N. Fault Tolerant File Server Operation:
   1. The system shall provide the option to provide fault tolerant operation in the event of the loss of the CPU, disk drives, or other hardware required to maintain the operational integrity of the system. Operational integrity includes all user interfaces, monitoring of alarm points and access points, and executing access control functions.
   2. The switchover mechanism provided shall be automatic. Should the failure be caused by hardware, and then the system shall immediately switch to the Backup computer. Should the system failure be caused by software (instruction or data), the system shall not pass the faulted code to the Backup computer, otherwise the Backup shall fail in the same manner of the Primary computer.
   3. Switchover to the Backup computer shall be initiated and effective (complete) in a manner and time frame that precludes the loss of event data, and shall be transparent to the system users, except for an advisory alarm message indicating that the switchover has occurred.
   4. When the system fails-over from the Primary to the Backup computer, no alarm or other event shall be lost, and the Backup computer shall take control of all system functions.
   5. A single component failure in the system shall not cause the entire system to fail. All system users shall be informed of any detectable component failure via an alarm event. System users shall not be logged off as a result of a system failure or switchover.
   6. The Primary computer shall provide continual indication that the Backup computer is unavailable until such time that the fault has been purged.
   7. Full screen, laptop service tools shall communicate directly to all controllers. The laptop software shall enable users to monitor both instantaneous and historical point data, modify control parameters, and enable/disable any point or program in any controller on the network.

O. Temperature Sensors
   1. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of -30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.
      a. Zone Sensors- Andover Model Number: TTS-SD-LCD-1
      b. Duct Sensors- Andover TT-D Series, Veris TJ Series, or equivalent
      c. Well Sensors- Andover TT-I Series
   2. Standard space sensors shall be available in an off white enclosure for mounting on a standard electrical box.
   3. Where manual overrides are required, the sensor housing shall feature both an optional Sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.
   4. Where a local display is specified, the sensor shall incorporate either an LED or LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.
   5. Duct temperature sensors shall incorporate a thermistor bead embedded at the tip of a stainless steel tube. Probe style duct sensors are useable in air handling applications where the coil or duct area is less than 14 square feet.
   6. Averaging sensors shall be employed in ducts, which are larger than 14 square feet. The averaging sensor tube must contain at least one thermistor for every 3 feet, with a minimum tube length of 12 feet.
   7. Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Thermal wells shall be brass or stainless steel for non-corrosive fluids below 250 degrees F and 300 series stainless steel for all other applications.
   8. A pneumatic signal shall not be allowed for sensing temperature.

P. Humidity Sensors
1. Humidity devices shall be accurate to +/- 5% at full scale for space and +/- 3% for duct and outside air applications. Provide Minco or Setra.

2. Provide a hand held field calibration tool that both reads the output of the sensor and contains a reference sensor for ongoing calibration.

Q. Pressure Sensors
1. Air pressure measurements in the range of 0 to 10" water column will be accurate to +/- 1 percent using a solid-state sensing element. Acceptable manufacturers include Setra and Dwyer.

2. Differential pressure measurements of liquids or gases shall be accurate to +/- 0.5% of range. The housing shall be Nema 4 rated. Acceptable manufacturers include Setra and Dwyer.

R. Current and KW Sensors
1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in solid core models, and offer either a digital or an analog signal to the automation system. Acceptable manufacturer is Veris or approved equal.

2. Measurement of three-phase power shall be accomplished with a kW/kWH transducer. This device shall utilize direct current transformer inputs to calculate the instantaneous value (kW) and a pulsed output proportional to the energy usage (kWh). Provide Veris Model 6000 Power Transducer or approved equal.

S. Flow Sensors
1. Provide an insertion flowmeter for measurement of liquid; gas or steam flows in pipe sizes above 3 inches.

2. Install the flow meter on an isolation valve to permit removal without process shutdown.

3. Sensors shall be manufactured by ONICON, Badger, or approved equal.

T. Electric/Pneumatic Transducers
1. Electric to pneumatic transducers shall operate from an analog signal. E/P transducers shall be rated for 0 - 20 psi operation and accurate to 2% of full scale. E/P transducers shall have a maximum air consumption of 100 SCIM.

2. E/P transducers may be installed at the end device (damper or valve), or mounted separately in a field interface panel, or in the control panel. All transducers will be calibrated. Panel mounted transducers shall be Mamac or approved equal.

U. Electric/Pneumatic Solenoid Valves: Electric solenoid operated pneumatic valves (EP's) shall have a three-port operation: common, normally open and normally closed. They shall be rated for 50 psig when used for 25 psig or less applications, or rated for 150 psig when used for 100 psig or less applications. The coils shall be equipped with transient suppression devices to limit transients to 150 percent of the rated coil voltage.

2.5 CONTROL VALVES

A. Provide automatic control valves suitable for the specified controlled media (Hot and Chilled Water). Provide valves, which mate and are compatible with the material of the connected piping. Equip control valves with the actuators of required input power type and control signal type to accurately position the flow control element and provide sufficient force to achieve required leakage specification. Control valves to be DuraDrive or equivalent.

B. Contractor to size valve Cv so that differential pressure at rated flow is between 3 to 5 psig for Chilled Water and 2 to 3.5 psig for Hot Water.
C. Control valves shall meet the heating and cooling loads specified, and close off against the differential pressure conditions within the application. Valves should be sized to operate accurately and with stability from 10 to 100% of the maximum design flow.

D. Electric actuation should be provided on all terminal unit reheat applications.

E. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator shall have electronic overload circuitry to prevent damage. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-spring return actuators shall have an external manual gear release to allow positioning of the damper when the actuator is not powered. Actuators to be DuraDrive or equivalent.

2.6 SMOKE DETECTORS

A. Smoke detector to be furnished and wired by Division 16, installed by Division 15.-Smoke Detector – Robertshaw Model Number: 2650-450

2.7 AIRFLOW MEASURING STATIONS

A. Provide a thermal anemometer using instrument grade self heated thermistor sensors with thermistor temperature sensors.

B. The flow station shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% over 500 feet/min and +/- 10 ft/min for reading less than 500 feet/min.

C. The output signal shall be linear with field selectable ranges including 0-5 VDC, 0-10VDC and 4-20 mA.

D. Furnish Ebtron Series GTx116 airflow stations or approved equal.

PART 3 EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

A. General: The BAS system is to be furnished and installed by an Andover approved Contractor. The Contractor shall certify all work as proper and complete. Under no circumstances shall the design, scheduling, coordination, programming, training, and warranty requirements for the project are delegated to a subcontractor.

B. Access to Site: Unless notified otherwise, entrance to building is restricted. No one will be permitted to enter the building unless their names have been cleared with the Owner or the Owner's Representative.

C. Code Compliance: All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring specifications in Division 15900 and Division 16, wiring requirements of Division 15900 will prevail for work specified in Division 17.

D. Cleanup: At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of grease, plaster, or other foreign materials.
3.2 WIRING, CONDUIT, TUBING AND CABLE

All wire will be copper and meet the minimum wire size and insulation class listed below:

<table>
<thead>
<tr>
<th>Wire Class</th>
<th>Wire Size</th>
<th>Isolation Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>12 Gauge</td>
<td>600 Volt</td>
</tr>
<tr>
<td>Class Two</td>
<td>14 Gauge Std.</td>
<td>600 Volt</td>
</tr>
<tr>
<td>Class Two</td>
<td>18 Gauge Std.</td>
<td>300 Volt</td>
</tr>
<tr>
<td>Class Two</td>
<td>18 Gauge Std.</td>
<td>300 Volt</td>
</tr>
<tr>
<td>Communications</td>
<td>Per Mfr.</td>
<td>Per Mfr.</td>
</tr>
</tbody>
</table>

A. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.

B. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

C. All building automation system wiring that attaches to the campus network shall comply with the requirements of Division 270000.

D. All wiring that is installed in concealed spaces such as walls, floor, or inaccessible ceiling spaces shall be installed in conduit. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Setscrew fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

E. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated cable. Plenum rated cable can be run without conduit above suspended ceilings. Cabling shall be installed in conduit systems in mechanical and electrical rooms, and in walls.

F. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.

G. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

H. Pneumatic tubing will be FR rated polyethylene instrumentation tubing, type M, hard copper tubing, or soft copper tubing. All pneumatic tubing will be sized for a maximum pressure drop of 2 PSI from the pressure-reducing valve to end device.

I. Coaxial cable shall conform to RG62 or RG59 rating. Provide plenum rated coaxial cable when running in return air plenums.
J. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140: Only glass fiber is acceptable, no plastic.

K. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS contractor shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

3.3 HARDWARE INSTALLATION

A. Installation Practices for Wiring and Tubing
   1. All controllers are to be mounted vertically and per the manufacturer’s installation documentation.
   2. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel. Conduit in finished areas will be concealed in furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
   3. Conduit, in non-finished areas where possible, will be concealed in furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.
   4. Wires are to be kept a minimum of three (3) inches from hot water, steam, or condensate piping.
   5. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.
   6. Wire or pneumatic tubing will not be allowed to run across telephone equipment areas.
   7. All wiring running down exposed fire rated walls to controls or control panels shall be run in EMT or completely enclosed in metal raceways.
   8. All control wiring in concrete walls or floors shall run in rigid conduit.
   9. All wiring that is installed in concealed spaces such as walls, floor, or inaccessible ceiling spaces shall be installed in EMT conduit.

B. Installation Practices for Field Devices
   1. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.
   2. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
   3. Waterline mounted sensors shall be removable without shutting down the system in which they are installed.
   4. For duct static pressure sensors, the high-pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low-pressure port shall be left open to the plenum area at the point that the high-pressure port is tapped into the ductwork.
   5. For building static pressure sensors, the high-pressure port shall be inserted into the space via a metal tube. Pipe the low-pressure port to the outside of the building.

C. Enclosures
   1. For all I/O requiring field interface devices, these devices where practical will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure, which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
   2. FIPs shall contain power supplies for sensors, interface relays and contactors, safety circuits, and I/P transducers.
   3. The FIP enclosure shall be of steel construction with baked enamel finish, NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for twenty percent spare mounting space. All locks will be keyed identically.
4. All wiring to and from the FIP will be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts on control signal wires within the FIP is prohibited.
5. All outside mounted enclosures shall meet the NEMA-4 rating.
6. The tubing and wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

D. Identification
1. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
2. Identify all pneumatic tubing with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
3. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.
4. Junction box covers will be marked to indicate that they are a part of the BAS system.
5. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with nameplates.
6. All I/O field devices inside FIP's shall be labeled.
7. Provide and install laminated wiring diagrams in cabinets and boxes containing standalone control units or network control units.

E. Location
1. The location of sensors is per mechanical and architectural drawings.
2. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light and diffuser air streams.
3. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
4. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced

3.4 SOFTWARE INSTALLATION

A. General: The software design and implementation is to be facilitated only by an Andover approved Contractor. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

B. Database Configuration: The Contractor will provide all labor to configure those portions of the database that are required by the point's list and sequence of operation.

C. Color Graphic Slides:
1. Unless otherwise directed by the owner, the Contractor will provide color graphic displays matching the Campus Standards for each system and floor plan.
2. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the owner.
   a. Animations and 3D Rendering.
   b. Animations to mimic all moving devised, status and operation.
   c. Animations set to maximum performance, compatible with Version 1.81.
   d. Individual slides; mechanical equipment, VAV/CAV boxes, pumps, motors, fans, dampers, thermostats, and valves.

D. Reports
1. The Contractor will configure a minimum of 6 reports for the owner as listed below:
b. VAV Status Report.

E. Documentation
1. As built software documentation will include the following:
   a. Descriptive point lists.
   b. Application program listing.
   c. Application programs with comments.
   d. Printouts of all reports.
   e. Alarm list.
   f. Printouts of all graphics.

3.5 COMMISSIONING AND SYSTEM STARTUP

A. Point to Point Checkout: Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Facilities Manager for submission to the owner’s representative.

B. Controller and Workstation Checkout: A field checkout of all controllers and front-end equipment (computers, printers, modems, etc.) shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the owner or owner's representative by the completion of the project.

C. System Acceptance Testing
1. All application software will be verified and compared against the sequences of operation. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.
2. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the owner.
3. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the owner.
4. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

END OF SECTION
SECTION 23 80 00

HEATING, VENTILATING AND AIR CONDITIONING

PART 1  GENERAL

1.1  SECTION INCLUDES

A.  Air inlets and outlets.
B.  Terminal Units.
C.  Dampers.
D.  Ductwork.
E.  Hydronic Piping.

1.2  RELATED DOCUMENTS

A.  Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B.  Section 23 00 50, Basic HVAC Materials and Methods.
C.  23 05 93, Testing, Adjusting, and Balancing for HVAC.
D.  Section 25 50 00, Automation Facility Controls.
E.  Section 23 09 00, Instrumentation and Controls for HVAC.

1.3  ADDITIONAL REQUIREMENTS

A.  Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.
B.  Coordinate all of work in this Section with all of the Trades covered in other Sections of the Specifications to provide a complete, operable and sanitary installation of the highest quality workmanship.

1.4  DESCRIPTION OF WORK

A.  Work of this section includes, but is not necessarily limited to Heating, Ventilating and Air Conditioning work indicated on the drawings and described herein.
1.5 QUALITY ASSURANCE

A. Design Criteria:
   1. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture. All gas-fired equipment shall be UL, ETL or CSA listed.
   2. Supply all equipment and accessories in accordance with requirements of applicable national, state and local codes.
   3. All items of a given type shall be products of the same manufacturer.
   4. Scheduled equipment performance is minimum capacity required.
   5. Scheduled electrical capacity shall be considered as maximum available.
   6. Scheduled gas BTU input shall be considered as maximum available.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, weight, corner or mounting point weights, furnished specialties and accessories; and installation and start-up instructions. Product data shall include applicable product listings and standards. Refer to Section 23 00 50, Basic HVAC Material and Methods for additional requirements.
   1. Upon approval of submittal, provide manufacturer’s installation and operating instructions to the Project inspector for the following:
      a. Fire dampers, smoke dampers, and combination smoke-fire dampers.

B. Engineering Data: Submit fan curves and sound power level data for each fan unit. Data shall be at the scheduled capacity. Data shall include the name of the rating agency or independent laboratory.

C. Maintenance Data: Submit maintenance data and parts list for each piece of equipment, control, and accessory; including "trouble-shooting guide," in Operation and Maintenance Manual.

D. Record Drawings: At project close-out, submit Record Drawings of installed ductwork, duct accessories, and outlets and inlets in accordance with requirements of Division 01.

E. Product Data for California Green Building Standards Code Compliance: For adhesives and sealants, including primers, documentation of compliance including printed statement of VOC content and chemical components.

1.7 COORDINATED LAYOUT

A. Coordinated layouts are required to amplify, expand and coordinate the information contained in the Contract Documents.

B. Provide minimum 1/4 inch equals one foot scaled coordination drawings showing plan and pertinent section or elevation views of all piping, ductwork and electrical systems. Drawings shall be on vellum or sepia mylar, reproducible and the work represented shall be fully coordinated with the structure, other disciplines, and with all finishes. Drawings shall all be presented on a single size sheet. Contractor may use either size D (24 inch x 36 inch) or E (36 inch x 42 inch). Drawings graphics shall fully comply with A.I.A. Architectural Graphic Standards and ANSI Y14. Drawings may be hand drawn or computer generated using AutoCad or "Quick Pen". All drawings shall have title block, key plan, north arrow and sufficient grid lines to provide cross-reference to the design drawings.
   1. Provide a stamp or title block on each drawing with locations for signatures from all contractors involved, including but not limited to the General, HVAC, Plumbing, Fire
Protection, and Electrical contractors. Include statement for signature that the contractor has reviewed the coordination drawings in detail and has coordinated the work of his trade.

2. Show on drawings the intended elevation of all ductwork in accordance with the following example.
   B.O.D. = 9'-0"
   OFFSET UP 6"
   B.O.D. = 9'-6"

3. Highlight, encircle or otherwise indicate deviations from the Contract Documents on the coordinated layouts. Architect will not be responsible for "finding" changes or deviations to the original Contract Documents.

C. Since scale of contract drawings is small and all offsets and fittings are not shown, contractor shall make allowances in bid for additional coordination time, detailing, fittings, offsets, hangers and the like to achieve a fully coordinated installation. If changes in duct size are required, equivalent area shall be maintained and the aspect ratio shall not be in excess of 2 to 1 unless approved by the engineer. Drawings shall be submitted for review prior to fabrication and installation. Drawings may be submitted in packages representing at least one quarter of the building ductwork.

D. Check routing on all ductwork before fabricating. Report any discrepancies to Architect. No extra cost will be allowed for failure to conform to above.

E. It shall be responsibility of the General Contractor to ensure that the Heating, Ventilating and Air Conditioning Contractor coordinates all of his work with all other trades, including mechanical and electrical trades, so that complete job is neat and in conformity with plans and specifications.

1.8 REFERENCES

A. AABC - Associated Air Balance Council

B. AFBMA - Anti Friction Bearing Manufacturer's Association

C. CSA – Canadian Standards Association International

D. AMCA - Air Moving and Control Association Inc.
   1. Standard 210 - Laboratory Methods of Testing Fans

E. ANSI - American National Standards Institute

F. ARI - Air-Conditioning and Refrigeration Institute

G. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers

H. ASME - American Society of Mechanical Engineers

I. ASTM - American Society of Testing and Materials

J. CCR - California Code of Regulations

K. CSFM - California State Fire Marshal

L. NIST - National Institute of Standards and Technology

HEATING, VENTILATING, AND AIR CONDITIONING

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M. NEMA - National Electrical Manufacturer's Association
N. NFPA - National Fire Protection Association
O. OSHA - Occupational Safety and Health Act
P. SMACNA - Duct Manuals
Q. CBC - California Building Code
R. UL - Underwriters' Laboratories, Inc.
S. CMC - California Mechanical Code
T. CPC - California Plumbing Code
U. CEC - California Electrical Code

PART 2 PRODUCTS

2.1 MATERIALS

A. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

2.2 AIR INLETs AND OUTLETs

A. Except as otherwise indicated, provide manufacturer's standard outlets and inlets where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Ceiling, wall or floor Compatibility: Provide outlets with border styles that are compatible with adjacent ceiling, wall or floor systems, and that are specifically manufactured to fit into ceiling, wall or floor module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems that will contain each type of air outlet and inlet.

C. Refer to Schedule on Mechanical Drawings for details of inlets and outlets to be used.

2.3 AIR TERMINAL UNITS

A. Shutoff, Single-Duct Air Terminal Units:
   2. Casing: 0.034-inch-thick galvanized steel, single wall
      a. Casing liner: Fibrous-glass duct liner, complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
         1) Minimum Thickness: 1 inch.
         2) Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
         3) Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant...
coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4) Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916. Adhesive VOC Content: 80 g/L or less.

b. Inlets and Outlets: Air inlet shall be round or rectangular stub connection or S-slip and drive connections for duct attachment. Air outlet shall be S-slip and drive connections, size matching inlet size.

c. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.

d. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.


a. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg 6-inch wg inlet static pressure.

4. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

5. Controls:

a. Air terminal units shall be furnished with damper and multipoint velocity sensor. Damper actuator, pressure-independent, variable-air-volume (VAV) or constant-air-volume (CAV) controller with electronic airflow transducer, and room sensor are specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC.

b. Control devices shall be compatible with temperature controls system

1) Electronic Damper Actuator: 24 V, powered open, spring.

2) Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) or constant-air-volume (CAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:

a) Occupied and unoccupied operating mode.

b) Remote reset of airflow or temperature set points.

c) Adjusting and monitoring with portable terminal.

d) Communication with temperature-control system.

3) Room Sensor: Wall mounted, with the following features:

a) Digital display of sensed temperature.

b) Local temperature setpoint adjustment. Capable of manual override through control system operator.

c) Local override to turn HVAC on. Capable of manual override through control system operator.

d) Access for connection of portable operator terminal.

6. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

Price Limited.
Titus.
Johnson Controls, Inc.

2.4 DAMPERS

A. Backdraft Dampers: Ruskin CBD2, counterbalanced, Nailer Industries, or equal.

B. Manual Air and Balance Dampers: Provide dampers of single blade type or multi-blade type constructed in accordance with SMACNA, "HVAC Duct Construction Standards," except as noted herein.

1. Rectangular Ductwork:
a. Single damper blades may be used in ducts up to 10 inches in height. Dampers shall be 16 gauge minimum. Provide self-locking regulators, equal to Ventlok 641. Provide end bearings equal to Ventlok 607 at each damper. Provide continuous solid 3/8 inch square shafts.

b. Multiple blade dampers shall be equal to Ruskin CD35 Standard Control Damper. Maximum width for multiple damper blades for use in rectangular duct shall not exceed 6 inches.

c. Where duct velocity may be expected to exceed 1500 fpm, provide Ruskin CD-50, or equal, low leakage dampers with airfoil blades.

2. Round Ductwork:

a. Single damper blades may be used in ducts up to 12 inches in diameter. Provide multiple blade opposed blade dampers, with connected linkage, for ductwork larger than 12 inches in diameter.

b. Damper blades for round ductwork shall be 20 gauge steel for ducts up to 12 inches diameter and 16 gauge steel for dampers larger than 12 inches damper. Provide self-locking regulators, equal to Ventlok 641, Durodyne, or equal for operation of dampers. Provide end bearings equal to Ventlok 607 and provide continuous solid 3/8 inch square shafts.

3. Where ductwork is externally insulated, provide self-locking regulators equal to Ventlok 644, Durodyne, or equal for rectangular ductwork, and Ventlok 637, Durodyne, or equal for round ducts.

C. Fire Dampers and Combination Fire/Smoke Dampers:

1. Fire dampers and combination fire/smoke dampers shall be listed and approved by the California State Fire Marshal. Installation shall conform to the manufacturer's UL approved installation instructions.

a. Fire dampers shall be UL 555 classified and labeled as dynamic fire dampers approved for wall and floor installation. They shall ship from the manufacturer as an assembly with a minimum 20-gauge factory installed sleeve. Sleeve length shall suit the requirements of the wall construction. Each dynamic fire damper/sleeve assembly shall ship complete with factory "roll formed" one-piece angles with pre-punched holes for easy installation. Dynamic fire dampers for vertical installation shall consist of a single section on sizes up to 33" x 36" and a single section on sizes up to 24" x 24" for horizontal installation. 1-1/2 hour dynamic fire dampers shall be Ruskin DIBD20, Pottorff. 3 hour dynamic fire dampers shall be Ruskin DIBD230, Pottorff.

b. Fire dampers for high pressure/velocity systems where velocities exceed 2000 fpm and/or 4" w.g. pressure fire damper shall be Ruskin FD60 or equal by Pottorff.

c. Fire dampers for ceiling installation shall be UL 555C classified and labeled as ceiling dampers. They shall be provided with a thermal insulating blanket to fit the inlet or outlet condition if required by the application. Ceiling dampers shall be Ruskin CFD 2, 3, 4 or 5. Ceiling dampers for ceilings constructed of wood shall have UL tested in design L501 and shall be Ruskin CFD7, equal by Pottorff.

d. Combination fire/smoke dampers. Dampers shall be UL classified and labeled as Leakage Class I Smoke Dampers in accordance with the latest version of UL 555S. Dampers shall be warranted to be free from defects in material and workmanship for a period of 5 years after date of shipment. Damper/actuator assembly shall be tested to full open and full close at minimum 2000 fpm 250° F heated air and 4" w.g. with airflow in both directions. (Specified select: 250°/350°, 2000 fpm/3000 fpm). Each damper shall be equipped with EZ reset "controlled closure" quick detect heat actuated release device to prevent duct and HVAC component damage resulting from instantaneous damper closure. Release device shall be EFL type and shall allow easy reset from outside the sleeve after moderate temperature exposure. (Replacement type fusible links not acceptable.)
e. Two position combination fire smoke dampers shall be equipped with one or more factory installed, direct coupled, 120 volt, single phase, electric actuator for energize open – fail close operation. Dampers with multiple actuators shall be factory wired with single point connection at the EFL heat release devise for connection to poser. Damper actuator shall include minimum one-year energized hold open (no cycles) and spring return (fail) close reliability. Damper/actuator shall include minimum 20,000 full open-full close cycle performances.

f. Modulating combination fire smoke dampers shall be equipped with one or more factory installed contact for modulating signal connection. Damper/actuator shall include minimum 100,000 full open-full close cycle performances with spring return (fail) close on loss of power.

g. Round combination fire smoke dampers up to 24" diameter shall be true round type with minimum 2- gauge minimum galvanized designed for lowest pressure drop and noise performance. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Blade seals shall be silicone edge designed to withstand 450°F and galvanized steel mechanically locked in to the blade edge (adhesive type seals are not acceptable). Each damper shall be equipped with a factory-installed sleeve of 17" minimum length and factory “roll formed” one-piece angles with pre-punched holes for easy installation. Dampers shall be Ruskin FSDR25 or equal by Pottorf.

h. Round (larger than 24" diameter) or rectangular combination fire smoke dampers shall include roll-formed structural hat channel frame, reinforced at the corners, formed from a single piece of minimum 16 gauge equivalent thickness formed from single piece galvanized steel. Bearings shall be stainless steel turning in an extruded hole in the frame. Blade edge seals shall be silicone rubber designed to withstand 450°F and galvanized steel mechanically locked in to the blade edge (adhesive type seals are not acceptable). Each damper shall be equipped with a factory-installed sleeve of 17" minimum length and factory “roll formed” one-piece angles with pre-punched holes for easy installation. Dampers shall be Ruskin FSD60 or equal by Pottorf.

i. 3-hour rated combination fire smoke dampers shall be Ruskin model FSD60-3 or equal by Pottorf.

j. All FSD60 type dampers shall be AMCA licensed and shall bear the AMCA Seal for Air Performance. AMCA certified testing shall verify pressure drop does not exceed .03" w.g. at a face velocity of 1,000 fpm on a 24" x 24" damper.

k. Wall type fire/smoke damper:

1) Combination fire/smoke dampers for use in the wall of exit corridors shall be classified and labeled as Leakage Class II Smoke Dampers in accordance with the latest version of UL 555S. Dampers shall meet the requirements for combination fire/smoke dampers in paragraph 3 above except AMCA certified testing shall verify pressure drop does not exceed .07" w.g. at a face velocity of 1,000 fpm on a 24" x 24" damper and blades shall be single skin galvanized steel 10 gauge minimum with 3 longitudinal grooves for reinforcement. Dampers shall be Ruskin FSD36 or equal by Pottorf.

2) Front access combination fire/smoke dampers shall meet all the requirements for combination fire/smoke dampers in paragraph 3 above except pressure drop requirement. In addition the dampers shall be constructed so that actuators and all accessories are accessible from the grille side. Actuators and accessories shall be housed within an integral cabinet on the side of the damper frame and shall not be installed in the air stream in front of the damper. The damper sleeve shall be minimum 14" and flanged to accept a steel framed grille. The sleeve shall be covered with fire resistant material. Dampers shall be Ruskin FSD60FA or equal by Pottorf.

l. Ceiling type fire/smoke damper for tunnel type corridor construction: Combination fire/smoke dampers for use in the corridor ceiling of tunnel type corridor construction shall be UL classified and labeled as Corridor Damper. Dampers shall meet the
requirements of paragraph 4a above except pressure drop testing does not require AMCA certification. Dampers shall be Ruskin FSD36C or equal by Pottorf.

m. Fusible links shall have temperature rating approximately 50° F above normal maximum operating temperature of the heat producing appliance.

1) If project requires re-openable fire/smoke dampers, provide Ruskin 165 °F / 350° F TS150, NCA or equal. The TS150 firestat replaces the EFL and allows the damper to be re-opened from remote location up to 350 °F. TS150 shall include full open and full closed damper position contacts for interface with remote position indication panel.

2) Each fire/smoke damper shall be equipped with "controlled closure" quick detect heat actuated release device to prevent duct and HVAC component damage. Release device shall allow easy reset after moderate temperature rise outside the sleeve. Heat release device shall be the Ruskin EFL, NCA or equal.

3) Unless the system is using a validation control system, each fire/smoke damper shall be equipped with a control panel including blade position indicator lights and a key operated switch. The panel cover shall be oversized for flush mount into the wall or ceiling and shall have a brushed look. Control panel shall be Ruskin MCP2, or equal by Pottorf.

2. All actuators used for smoke dampers or combination fire/smoke dampers shall have a cycle time requirement of not more than every twelve months and shall be rated for continuous "On" duty and shall be provided with internal spring return. Actuators shall be equipped with pilot light, remote key test switch, end switch and circuitry to activate pilot light on remote key (test) switch located in corridor ceiling adjacent to damper. Electric motors shall be Invensys MA-250, MA-253, Honeywell H2000, or equal.

2.5 DUCTWORK

A. Construct and install all sheet metal ductwork in accordance with the California Mechanical Code for 2 inches static pressure for supply air, and 2 inches minimum for return and exhaust air unless otherwise noted on Drawings.

B. Construct and install sheet metal ductwork in accordance with the California Mechanical Code for 4 inches static pressure upstream of terminal units and 2 inches minimum downstream of terminal units for supply air, and 2 inches minimum for return and exhaust air unless otherwise noted on Drawings.


2. Provide variations in duct size, and additional duct fittings as required to clear obstructions and maintain clearances as approved by the Architect at no extra cost to the Owner.

3. Gauges, joints and bracing shall be in accordance with the California Mechanical Code.

4. Provide beading or cross breaking for all ductwork inside building. Provide cross breaking for ductwork exposed to weather.

5. At the contractor's option, ductwork may be fabricated using the Ductmate, Nexus, Quickduct, Transverse Duct Connection (TDC), Pyramid-Loc duct connection systems, or equal. Fabricate in strict conformance with manufacturer's written installation instructions and in accordance with California Mechanical Code.

a. Seal flanged ends with pressure sensitive high density, closed cell neoprene or polyethylene tape gasket, Thermo 440, or equal.

b. Provide metal clips for duct connections, except at breakaway connections for fire dampers and fire smoke dampers. Provide corner clips at each corner of duct, through bolted, at all locations except at breakaway connections for fire dampers and fire smoke dampers. Where used on locations exposed to weather, provide continuous metal clip at top and sides of duct, with 1 inch overhang for top side.
C. Design and installation standards:
   1. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor’s National Association (SMACNA) for all work in this section.

D. Fabricate all ductwork with sheet metal. Fiberglass ductwork will not be accepted for use on this project.

E. Duct sizes indicated are external sizes.

F. Galvanized Sheet Steel: Lock-forming quality, ASTM A924 and ASTM A653, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.
   1. Provide mill certification for galvanized material at request of the Project Inspector.

G. Duct Sealing:
   1. Sealant shall have a VOC content of 250 g/L or less.
   2. Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
   3. Seal airtight all joints and seams, including standing seams and manufactured joints and seams, of all supply, return and exhaust ducts except those exposed in conditioned space. Provide one part, non-sag, synthetic latex sealant, formulated with a minimum of 68 percent solids. Sealant shall comply with ASTM E84, Surface Burning Characteristics.
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
         1) Design Polymeric’s, model DP1010
         2) Polymer Adhesive Sealant Systems Inc, model Airseal #11
         3) McGill Airseal, LLC

H. Provide sheet metal angle frame at all duct penetrations to wall, floor, roof, or ceiling.

I. Duct Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, straps, trim, and angles for support of ductwork.

J. Rectangular Duct Fabrication:
   1. Shop fabricate ductwork of gauges and reinforcement complying with the more stringent of the following standards, except as noted herein.
      a. SMACNA HVAC Duct Construction Standards
      b. California Mechanical Code
   2. Fabricate ducts for 2 inch pressure class with minimum duct gauges and reinforcement as follows, except as otherwise noted:

<table>
<thead>
<tr>
<th>Duct Dimension</th>
<th>Minimum Gauge</th>
<th>Joint Reinforcement Per CMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through 12&quot;</td>
<td>26</td>
<td>Not Required</td>
</tr>
<tr>
<td>13&quot; through 18&quot;</td>
<td>24</td>
<td>Not Required</td>
</tr>
<tr>
<td>19&quot; through 30&quot;</td>
<td>24</td>
<td>C/4</td>
</tr>
<tr>
<td>31&quot; through 42&quot;</td>
<td>22</td>
<td>E/4</td>
</tr>
</tbody>
</table>

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3. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1.5 times associated duct width. Fabricate to include single thickness turning vane in elbows where space does not permit the above radius or where square elbows are shown. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers. Turning vanes shall be E-Z Rail II, Durodyne, or equal.
4. Fabricate round supply connections at rectangular, plenum type fittings using spin-in type fittings, complete with extractor and volume control damper. Refer to Paragraph “DAMPERS” for damper requirements.
5. Provide drive slip or equivalent flat seams for ducts exposed in the conditioned space or where necessary due to space limitations. On ducts with flat seams, provide standard reinforcing on inside of duct. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.
6. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
7. Provide 20 gauge minimum for ductwork exposed within occupied spaces.

K. Rectangular Internally Insulated Duct Fabrication:
1. Provide internal duct lining where indicated on the Drawings, with a minimum of 10'-0" length in each direction from the fan, fan casing, or unit casing. Line all transfer ducts.
   a. Where ductwork is within the building insulation envelope, lining shall be 1" thick, 1-1/2 pound density, with R-value of 4.2 minimum.
   b. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
   c. Where installed exposed in the conditioned space, duct shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value – R-4.2).
   d. Cement duct liner in place with nonflammable, non-hardening duct adhesive. Seal all raw edges of insulation inside ductwork with adhesive, including longitudinal liner edges.
   e. Provide metal nosing at all locations where liner is preceded by unlined metal.
   f. Provide sheet metal weld pins and washers or clinch pins and washers on all ductwork on 12 inch intervals with the first row within 3 inches of the leading edge of each piece of insulation and within 4 inches of corners. No use of adhesive mounted pins will be considered.
      1) Install clinched pin fasteners with properly adjusted automatic fastening equipment. Manual installation will not be considered.
      2) Install weld pins with properly adjusted automatic fastening equipment. Installation shall not damage the galvanized coating on the outside of the duct.
   g. All ductwork, adhesives, lining, sealant, flex duct and the like shall have a flame spread of 25 or less and developed smoke rating of 50 or less when tested in accordance with one of the following test methods: NFPA 255, ASTM E84, or UL 723.
h. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johns Manville</td>
<td>Duct Liner PM</td>
</tr>
<tr>
<td>CertainTeed Corporation</td>
<td>ToughGard</td>
</tr>
<tr>
<td>Fosters Adhesive</td>
<td>85-62</td>
</tr>
<tr>
<td>Swifts Adhesive</td>
<td>7336</td>
</tr>
</tbody>
</table>

L. Round and Oval Ductwork Fabrication:

1. Round and oval duct and fittings shall be spiral lockseam or longitudinal seam as indicated in table below. Provide couplings to join each length of duct.
   a. At contractors’ option, round or oval ductwork may be utilized in place of rectangular ductwork shown on Drawings, provided available space allows installation of round or oval ductwork without compromising space required for installation of products and systems of other trades.
      1) Round or oval ductwork utilized in place of rectangular ductwork shown on Drawings shall be sized to have a static pressure loss equivalent to rectangular duct shown on Drawings.
      2) Unlined round or oval duct shall not be utilized in place of rectangular internally lined ductwork shown on Drawings.
   2. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1.5 times associated duct width. Provide two-piece, die-stamped, 45-degree to 90-degree elbows for sizes up to 12 inches; five-piece, 90-degree elbows for sizes 12 inches and above; conical tees; and conical laterals. All reducers shall be placed after a tap has been made on the duct main. Reducers shall be long-taper style.

2. Round Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 653 by the following methods and in minimum gauges listed.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Minimum Gauge</th>
<th>Method of Manufacture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 14&quot;</td>
<td>26</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>15&quot; to 23&quot;</td>
<td>24</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>24&quot; to 36&quot;</td>
<td>22</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>37&quot; to 50&quot;</td>
<td>20</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>51&quot; to 60&quot;</td>
<td>18</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>Over 60&quot;</td>
<td>14</td>
<td>Longitudinal Seam</td>
</tr>
</tbody>
</table>

4. Provide locked seams for spiral duct; fusion welded butt seam for longitudinal seam duct.

5. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous welds along seams at exposed ducts. Provide spot weld bonded seams at concealed ducts.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Minimum Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; to 36&quot;</td>
<td>20</td>
</tr>
</tbody>
</table>
38" to 50"
Over 50"

6. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.

7. Provide 20 gauge minimum for ductwork exposed within occupied spaces.

M. Round Internally Insulated Duct and Fittings: Where ductwork is exposed to weather or outside the building insulation envelope, construct with outer pressure shell, 2 inch thick (Minimum R-value = R-8) insulation layer, and perforated inner liner. Where ductwork is within the building insulation envelope, construct with outer pressure shell, 1 inch thick (minimum R-value = R4.2) insulation layer, and perforated inner liner. Construct shell and liner of galvanized sheet steel complying with ANSI/ASTM A 653, of spiral lockseam construction (use longitudinal seam for over 59 inches), in minimum gauges listed in table below. Where installed exposed in the conditioned space: duct and fitting outer pressure shell shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value = R-4.2), and perforated inner liner.

<table>
<thead>
<tr>
<th>Nominal Duct Diameter</th>
<th>Outer Shell</th>
<th>Inner Liner</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; TO 12&quot;</td>
<td>26 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>13&quot; TO 24&quot;</td>
<td>24 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>25&quot; to 34&quot;</td>
<td>22 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>35&quot; to 48&quot;</td>
<td>20 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>49&quot; to 58&quot;</td>
<td>18 gauge</td>
<td>24 gauge</td>
</tr>
<tr>
<td>Over 59&quot;</td>
<td>16 gauge</td>
<td>20 gauge</td>
</tr>
</tbody>
</table>

1. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams of outer shell at exposed ducts. Provide spot weld bonded seams at concealed ducts.

Nominal Duct Diameter | Outer Shell | Inner Liner |
-----------------------|-------------|-------------|
3" to 34"              | 20 gauge    | 24 gauge    |
36" to 48"             | 18 gauge    | 24 gauge    |
Over 48"               | 16 gauge    | 24 gauge    |

2. Inner Liner: Perforate with 3/32 inch holes for 22 percent open area. Provide metal spacers welded in position to maintain spacing and concentricity.

3. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.

4. Where installed exposed in the conditioned space, duct shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value = R-4.2).

5. All ductwork, adhesives, lining, sealant, flex duct and the like shall have a flame spread of 25 or less and developed smoke rating of 50 or less when tested in accordance with one of the following test methods: NFPA 255, ASTM E84, or UL 723.

6. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

b. Semco Duct and Acoustical Products, Inc.
c. Air Systems Manufacturing, Inc. - Las Vegas

N. Duct Access Doors:
1. Duct Access: Provide hinged access door in rectangular ducts for access to fire dampers, control equipment, etc. Access door size shall be duct diameter wide by duct diameter high for all ducts under 24 inches. Ducts over 24 inches in diameter shall have 24-inch by 18-inch access doors. Minimum size access doors shall be 6 inches by 6 inches.
2. Provide hinged style access doors for round ductwork, NCA Manufacturing, Inc., Model AD-RD-87, Pottorf Series 60, or equal. Access doors shall be 16 gauge galvanized steel with continuous piano hinge. Locks shall be plated steel strike and catch. Provide 1" x 3/8" Polyethylene "Perma Stik" gasket all around door.

O. Flexible Air Ducts:
1. Provide exterior reinforced laminated vapor barrier, fiberglass insulation, encapsulated spring steel wire Helix, and impervious, smooth, non-perforated interior vinyl liner. Individual lengths of flexible ducts shall contain factory fabricated steel connection collars.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
      C.A. Schroeder, Inc., Cal Flex model 2PMJ
      ThermaFlex model M KC
   b. Factory made air ducts shall be approved for the use intended and shall conform to the requirements of UL 181 and NFPA 90A. Each portion of a factory-made air duct system shall be identified by the manufacturer with a label or other suitable identification indicating compliance with UL 181, Class 1. Ducts shall be UL listed Class 1, maximum 25/50 smoke and flame spread and shall be installed in accordance with the terms of their listing and the requirements of SMACNA HVAC Duct Construction Standards (Metal and Flexible). Factory-made air ducts shall have the following minimum R-values: R-6.0 for ductwork installed within the building insulation envelope, R-8.0 for ductwork installed outside the building insulation envelope.
2. Flexible ductwork shall be maximum of 8 feet long, and shall be extended to the fullest possible length, in order to minimize pressure drop in the duct.
3. Flexible ducts shall be selected for minimum of 6 inch positive static pressure and minimum of 1 inch negative static pressure.
4. Duct Access Panels:
   a. Provide duct access panel assembly of the same material and gauge used for the duct. Duct access panels shall conform to the following:
      1) Fasteners: Black steel or stainless steel to match material used for the duct. Panel fasteners shall not penetrate duct wall.
      2) Gasket: Comply with NFPA 96, grease-tight, high temperature ceramic fiber, rated for minimum 1500 °F.

P. Shower exhaust ducts: Provide ducts and supports from stainless steel for a length of 20 feet from exhaust grille or register.

2.6 HYDRONIC PIPING

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Provide materials and products complying with California Mechanical Code. Where more than one type of material or product is indicated, selection from materials or products specified is Contractor's option.

B. Chilled Water, Heating Hot Water, and Condenser Water Piping:

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1. Copper Tube and Fittings Aboveground:
   a. Copper Tube and Fittings Aboveground: ASTM B88, Type L, drawn-temper, 150 psig minimum working pressure at 200 deg. F. Provide wrought-copper fittings and unions, ASTM B16.22, with full solder cup. Capped outlets shall be Schedule 40 screwed brass. Contractor's option: For piping 2-1/2 inches and larger, grooved-end copper fittings, ASTM B 75 or ASTM B 584, and grooved-end tube couplings, rigid pattern, with steel bolts and nuts and pre-lubricated EPDM gasket rated for minimum 230 deg. F. Fittings and coupling shall be rated minimum 200 psig working pressure at 250 deg. F.

2. Steel Pipe and Fittings Aboveground:
   a. 2 inches and smaller: ASTM A 53/A 53M, Schedule 40 black steel with plain ends, 150 psig minimum working pressure at 200 deg. F. Provide malleable-iron threaded fittings, ASTM B16.3, Class 150, and unions, ASTM B16.39, Class 150, and cast-iron flanges and flange fittings, and threaded joints.
   b. 2-1/2 inches and larger: ASTM A 53/A 53M, Schedule 40 black steel with plain ends, 150 psig minimum working pressure at 200 deg. F. Provide wrought-steel fittings, ASTM A 234/A 234M, and wrought-cast or forged-steel flanges and flange fittings, ASME B16.5, material group 1.1, with butt welding end connections and raised face.
   1) Contractors option: Grooved-end system as follows:
   2) Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   3) Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   4) Refer to Grooved-End Fittings and Couplings Schedule in PART 3 of this Section for application of grooved-end fittings and couplings.

PART 3 EXECUTION

3.1 AIR INLETS AND OUTLETS

A. Provide all air inlets and outlets with gaskets and install so that there will be no streaking of the walls or ceilings due to leakage. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.

B. Unless otherwise indicated on Drawings, provide rectangular plenum on top of each diffuser and ceiling return for connection to ductwork. Line plenum with internal insulation as indicated for lined ductwork. Size plenum to allow full opening into air terminal.

C. Ceiling-mounted air terminals or services installed in T-Bar type ceiling systems shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
   1. Terminals or services weighing not more than 56 pounds shall have two No. 12 gauge hangers connected from the terminal or service to the structure above. These wires may be slack.
   2. Support terminals or services weighing more than 56 pounds directly from the structure above by approved hangers. Provide 4 taut 12 gauge wires each, attached to the fixture and to the structure above. The 4 taut 12 gauge wires, including their attachment to the structure above must be capable of supporting 4 times the weight of the unit.
   3. Secure air inlets and outlets to main runners of ceiling suspension system with two #8 sheet metal screws at opposing corners.
D. Furnish all air inlets and outlets with a baked prime coat unless otherwise noted. Provide off-white baked enamel finish on ceiling-mounted air inlets and outlets. Paint exposed mounting screws to match the material being secured.

E. Air inlets and outlets shall match all qualities of these specified including appearance, throw, noise level, adjustability, etc.

3.2 AIR TERMINAL UNIT INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

D. Connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange, or as detailed on Drawings.

3.3 DAMPERS

A. All dampers automatically controlled by damper motors are specified under "Temperature Control System" except those specified with items of equipment.

B. Provide opposed blade manual air dampers at each branch duct connection and at locations indicated on the drawings and where necessary to control airflow for balancing system. Provide an opposed blade balancing damper in each zone supply duct. Provide an access panel or Ventlok flush type damper regulator on ceiling or wall for each concealed damper.

C. Install fusible link fire dampers full size of duct at points where shown or required.

D. Provide 18 inch x 12 inch minimum hinged access doors in ductwork and furring for easy access to each fire damper; insulated access doors in insulated ducts. Label access doors with 1/2 inch high red letters.
   1. Provide Ventlok Series 100, Durodyne, or equal access doors with hardware for convenient access to all automatic dampers and other components of the system, insulated type in insulated ducts. Provide Ventlok #202 for light duty up to 2 inch thick doors, #260 heavy-duty up to 2 inch thick doors and #310 heavy-duty for greater than 2 inch thick doors. Provide #260 hinges on all hinged and personnel access doors; include gasketing.

3.4 INSTALLATION OF DUCTWORK

A. Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true to shape and to prevent buckling. Where possible, install ductwork to clear construction by 1/4 inch minimum, except at air inlets and outlets. Where ductwork will not clear construction, secure duct firmly to eliminate noise in the system.
B. Duct Joints: Install duct sealers, pop rivets or sheet metal screws at each fitting and joint. Duct sealer shall be fire retardant. Sheet metal screw for joints shall be minimum #10 size galvanized.

C. Applicable Leakage Classes:

<table>
<thead>
<tr>
<th>Pressure Class</th>
<th>Leakage Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Round Duct</td>
</tr>
<tr>
<td>2&quot;W.G. or less</td>
<td>12</td>
</tr>
<tr>
<td>4&quot;W.G. or greater</td>
<td>3</td>
</tr>
</tbody>
</table>

D. Upper connection of support to wood structure shall be with wood screws or lag screws in shear fastened in the upper one half of the wood structural member. Fasteners shall conform to the following schedule:

- For ducts with P/2=30" #10 x 1-1/2" wood screw
- For ducts with P/2=72" 1/4" x 1-1/2" lag screw
- For ducts with P/2 over 73" 3/8" x 1-1/2" lag screw

E. Upper connection in tension to wood shall not be used unless absolutely necessary. Where deemed necessary the contractor shall submit calculations to show the size fastener and penetration required to support loads in tension from wood in accordance with the following schedule:

- For ducts with P/2=30" 260 pounds per hanger
- For ducts with P/2=72" 320 pounds per hanger
- For ducts with P/2=96" 460 pounds per hanger
- For duct with P/2 larger than 120" NOT ALLOWED

F. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct plus insulation with sheet metal flanges of same gauge as duct. Overlap opening on four sides by at least 1-1/2 inches.

G. Support ductwork in manner complying with SMACNA "HVAC Duct Construction Standards," hangers and supports sections. Where special hanging of ductwork is detailed or shown on Drawings, Drawings shall be followed. Angles shall be attached to overhead construction in a manner so as to allow a minimum of 2 inches of movement in all directions with no bending or sagging of the angle.

1. Except where modified in individual paragraphs of this Section, provide hanger support with minimum 18 gauge straps, 1 inch wide. Fold duct strap over at bottom of duct.
2. Install duct supports to rectangular ducts with sheet metal screws. Provide one screw at top of duct and one screw into strap at bottom of duct.

H. Installation of Flexible Ductwork:

1. Provide flexible ducts with supports at 30 inch centers with 2 inch wide, 26 gauge steel hanger collar attached to the structure with an approved duct hanger. Installation shall minimize sharp radius turns or offsets.
a. Supports shall be in accordance with SMACNA HVAC Duct Construction Standards (Metal and Flexible).
b. Make bends to maintain R/W-1.5.

2. Make connections to rigid duct and units with Panduit style draw band at inner liner material, and a second draw band over the outer vapor barrier material.

3. Make connection to duct with spin-in fittings, with air scoop and balance damper.

I. Installation of Shower Exhaust Ducts:
1. Slope duct a minimum of 1 percent to drain back to the exhaust grille.

J. Paint inside of ducts, visible through grille, dull black.

K. Where ductwork is installed in finished areas of buildings that do not have ceilings, paint ductwork, support hangers, and air inlets and outlets to match adjacent architectural surfaces, or as directed by Architect.

3.5 DUCTWORK SEALING AND LEAK TESTING

A. Retrofit Construction, including alterations to existing duct system or space conditioning equipment: All duct systems (supply, return, outside air intake and exhaust), except those exposed in the conditioned space, shall be sealed and leak tested in strict conformance with the requirements of the 2013 California Building Energy Efficiency Standards. See drawings for extent of this work and leakage rate requirements. The leakage rate shall be confirmed through field verification and diagnostic testing in accordance with the procedures set forth in the 2013 California Building Energy Efficiency Standards Reference Appendices. Contractor shall also complete the Acceptance Requirements in the standards for duct sealing/leak testing. Refer to Section 23 00 50 for additional information on Acceptance Requirements.

3.6 TEMPERATURE CONTROL SYSTEM

A. Provide thermostats where indicated on drawings. All wiring shall be in conduit. Provide all relays, transformers and the like to render the control system complete and fully operable. All control conduit to be rigid steel type.

3.7 EQUIPMENT START-UP

A. Initial start-up of the systems and pumps shall be under the direct supervision of the Contractor.

B. Equipment start-up shall not be performed until the piping systems have been flushed and treated and the initial water flow balance has been completed.

C. It shall be the responsibility of the Contractor to assemble and supervise a start-up team consisting of controls contractor, start-up technician, and test and balance contractor; all to work in concert to assure that the systems are started, balanced, and operate in accordance with the design.

D. After start-up is complete, instruct the Owner's personnel in the operation and maintenance of the systems. Obtain from the Owner's representative a signed memo certifying that instruction has been received.

3.8 TESTING AND BALANCING
A. For testing and balancing requirements, refer to Section 23 05 93, Testing and Balancing for HVAC.

3.9 CLEANING AND PROTECTION

A. As each duct section is installed, clean interior of ductwork of dust and debris. Clean external surfaces of foreign substances that might cause corrosive deterioration of metal or where ductwork is to be painted.

B. Temporary Closure: At ends of ducts that are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering that will prevent entrance of dust and debris until connections are to be completed.

C. As each internally lined duct section is installed, check internal lining for small cuts, tears, or abrasions. Repair all damage with fire retardant adhesive.

3.10 ACCEPTANCE REQUIREMENTS

A. In addition to the testing and balancing requirements specified in Section 23 05 93, the Contractor shall also be responsible to complete the Acceptance Requirements of the 2013 California Building Energy Efficiency Standards. Refer to Section 23 00 50 for additional information on Acceptance Requirements.

3.11 EQUIPMENT MOUNTING

A. Mount and anchor equipment in strict compliance with Drawings details. Alternate anchorage methods will not be considered for roof mounted equipment.

3.12 GROOVED-END FITTINGS AND COUPLINGS SCHEDULE

A. Optional grooved-end fittings and couplings shall be utilized as follows:

1. Chilled and condenser water piping:
   a. Mechanical Rooms, where accessible for service or replacement.
   b. Above lay-in type suspended ceilings, where accessible by ladder.
   c. Outside building above grade.

2. Heating hot water piping:
   a. Mechanical Rooms, where accessible for service or replacement.

3. Grooved-end fittings and couplings shall not be installed in vertical building shafts.

END OF SECTION
SECTION 26 01 00
BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions and Division 1, General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Related Work in Other Sections, but not limited to the following:
   1. Motors, motor controls and low voltage conduit and control wiring that are an integral part of equipment assemblies and heating and ventilation controls.
   2. Painting of exposed electrical work.
   3. Plumbing controls and low voltage wiring.

B. Work Included in Contract
   1. Grounding and bonding per NEC.
   2. Disconnect and remove existing electrical conduit and wiring and provide new as shown on plans.
   3. Provide new 120/208v, 3 phase, 4 wire branch circuit panel as shown on plans.
   4. Replace existing lighting with new with new Title 24 compliant controls.
   5. Replace existing receptacles and other 120v components as shown on plans.
   6. Provide wiring and hookup of all electrical equipment specified under other specification sections, such as technology systems, mechanical and plumbing equipment.
   7. Provide and install a new complete addressable fire alarm system per District standards as detailed on drawings and specifications and specified under Division 27 and connect to existing fire alarm system.

1.3 CODES AND STANDARDS

A. In addition to Codes and Standards - Division 1, the following shall apply to this Division:
   National Electrical Code with California amendments
   U.L. Electrical Construction Materials List
   Codes, rules and regulations as specified hereinafter
   Local city and county agencies
   International Building Code

1.4 SUBMITTALS

A. Submittals shall be made in conformance with the General Conditions. The list shall include, for each item, the manufacturer, manufacturer’s catalog number, type of class, the rating, capacity, size, etc. Submittals shall include:
   1. Light Fixtures
   2. Circuit Breakers
   3. Conduit & Fittings
   4. Boxes & Covers
   5. Fuses
   6. Wire & Cable
7. Wiring Devices  
8. Disconnect Switches  
9. Panelboards  
10. Fire Alarm System

B. Shop Drawings: Submit for approval, detailed construction drawings for each item of fabricated equipment required for the electrical installation. All drawings shall be to scale, fully dimensioned, and provide sufficient detail to clearly indicate the arrangement of the equipment and its component parts. Construction of the equipment shown shall be revised to comply with the drawings and specifications as required by the Architect after review of the shop drawings, and the drawings submitted when requested by the Architect. Shop drawings shall be submitted for the following:

1. Lighting Controls  
2. Fire Alarm System

C. Substitution: Provide substitutions as outlined.

1.5 SUPERVISION OF ELECTRICAL WORK

A. Contractor shall personally, or through an authorized and competent representative, constantly supervise the work from beginning to completion and final acceptance. So far as possible, keep same foreman and workmen throughout the project duration. Work shall be subject to inspection and approval by Architect. Promptly furnish related information when so requested by Architect.

1.6 EQUIPMENT AND SYSTEMS IDENTIFICATION

A. General: All panels, terminal cabinets, etc., shall be labeled as to identification and use. In general, equipment shall be identified in accordance with drawings. Identification tags, signs, labels and markers shall comply with OSHA and ANSI requirements.

B. Nameplates: All equipment, terminal cabinets, panels and systems shall be identified by laminated, engraved plastic, white on black plates permanently attached to the equipment. Voltage and phase shall be listed on these plates.

C. All terminal cabinets to have terminal strips and all wiring in terminal cabinets shall be tagged.

D. Directories: Provide for power circuits, typewritten, neatly arranged in numerical order, and permanently fixed inside all new and existing panels.

E. Provide lamecoid label on all receptacle and switch covers indicating complete circuit number.

F. Provide lamecoid label on all blank cover plates indicating circuit number or low voltage system (i.e. future data, intrusion, etc.).

G. Provide lamecoid label on all fire alarm device covers indicating complete device number.

H. Provide service description etched on cover of all underground pull boxes.

1.7 OPERATING INSTRUCTIONS ON-SITE

A. At time of occupancy, arrange for manufacturer’s representatives to instruct building operating and maintenance personnel in use of any equipment requiring operating and maintenance.
Arrange for all personnel to be instructed at one time. Pay all costs for such service (minimum of 4 hours).

1.8 ADJACENT WORK

A. Coordinate work and complete with others in furnishing and placing this work.

B. Work to approved shop drawings for work by others and to field measurements as necessary to properly fit the work.

C. Project adjacent work as necessary; adjacent construction or exposed surfaces or surfaces damaged by use of materials or operations under this Section shall be repaired or replaced as directed by Architect.

1.9 DRAWINGS

A. The electrical drawings, which constitute an integral part of this contract, shall serve as the working drawings. They indicate diagrammatically the general layout of the complete electrical system, including the arrangement of feeders, circuits, panelboards, service equipment, and other work. Field verifications of scale dimensions taken from the drawings are directed since actual field locations, distances and elevations will be governed by actual field conditions. Review architectural, structural, mechanical and plumbing drawings and adjust work to conform to all conditions indicated thereon. Discrepancies shown on different plans or between plans and actual field conditions, or between plans and specifications, shall promptly be brought to the attention of the Architect for a decision.

1.10 COORDINATION AND COOPERATION

A. Drawings and specifications are both supplementary and complementary. Taken together, they are intended to define complete working installations of the systems represented, in accordance with approved practice in the trade, and in conformity with all applicable requirements of local jurisdictional offices and officers and codes and enforcing bodies.

B. It shall be presumed that any bid offered under this Division of the Specifications is based on a careful examination of the job site, and of the plans and specifications; that the person(s) or firm(s) awarded a contract hereunder is/are experienced and qualified in the type of work represented; that every effort has been made to prepare complete, accurate and correct plans and specifications; and that reasonable diligence will be exercised in planning and scheduling the work to anticipate conflicts and/or detect errors or omissions. All such shall be immediately reported, and proper resolution agreed on between concerned parties before the work affected is performed. If due to lack of diligence, or to incompetence, failure to anticipate such problems shall not create a valid claim for extra costs or charges.

C. Requirements of other trades, of utility companies, and of fire departments, protective services, communication systems, or other facilities of a utility nature, shall be determined prior to installation of systems, equipment, devices or materials affected by or dependent on such requirements.

D. Unapproved deviations or changes based on a presumption of error or code violation, or work not suitable for its intended function, may not be accepted.

E. Nothing herein shall act to prevent or discourage the contractor from suggesting or discussing possible changes in the work where such might be beneficial to the contractor or the owner, or
might facilitate the work of this or other trades.

F. Any work resulting in a claim for a change in the contract price must be approved and fully documented.

1.11 VISIT TO SITE

A. Visit the project site, take requisite measurements, and verify exact location of buildings, utilities, and other facilities, and obtain such other information as is necessary for an intelligent bid. No allowance will subsequently be made by the Architect or Owner for any error or omission on the part of the bidder in this connection.

1.12 RECORD DRAWINGS

A. Record of Job Progress: Keep an accurate dimensional record of the "as-built" locations and of all work; all as required. This record shall be kept up-to-date on blueline prints as the job progresses and shall be available for inspection at all times. It shall be reviewed by inspector prior to each monthly application for payment.

B. Record of Installation: Refer to Supplementary General Conditions.

C. Include on "as-built" drawings:
   1. Routing of all buried or concealed electrical feeders and conduits.

D. Upon completion of the work, a completed set of as-built reproducible vellums and electronic file (ACAD 2010) on Cd/DVD disk(s) shall be delivered to the Architect.

1.13 GUARANTEE

A. All work shall be guaranteed for a minimum period of one year from either the official date of completion or from the date of acceptance by the Owner, whichever is the later date. The guarantee period for certain items shall be longer, as indicated in the specification for those items.

B. Should any trouble develop during the guarantee time due to defective material, faulty workmanship, or non-compliance with plans, specifications, codes or directions of the Owner, Architect, Engineer or Inspector, the Contractor shall furnish all necessary labor and materials to correct the trouble without additional charges.

END OF SECTION
SECTION 26 05 00

MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Electrical identification.
   2. Concrete equipment bases.
   3. Electrical demolition.
   4. Cutting and patching for electrical construction.

1.2 SUBMITTALS

A. Product Data: For utility company electricity-metering components.

B. Shop Drawings: Dimensioned plans and sections or elevation layouts and single-line diagram of electricity-metering component assemblies specific to this Project.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.4 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings for electrical supports, raceways, and cable with general construction work.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment that requires positioning before closing in the building.

C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs. Strength rating to suit structural loading.
D. Slotted Channel Fittings and Accessories: Recommended by the manufacturer for use with the type and size of channel with which used.
   1. Materials: Same as channels and angles, except metal items may be stainless steel.

E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

H. Expansion Anchors: Carbon-steel wedge or sleeve type.

I. Toggle Bolts: All-steel springhead type.


2.2 ELECTRICAL IDENTIFICATION

A. Identification Device Colors: Use those prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.

C. Tape Markers for Conductors: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

D. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

E. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape compounded for permanent direct-burial service, and with the following features:
   1. Not less than 6 inches wide by 4 mils thick.
   2. Embedded continuous metallic strip or core.
   3. Printed legend that indicates type of underground line.

F. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.

G. Warning and Caution Signs: Preprinted; comply with 29 CFR 1910.145, Chapter XVII. Colors, legend, and size appropriate to each application.
   1. Interior Units: Aluminum, baked-enamel-finish, punched or drilled for mechanical fasteners.
   2. Exterior Units: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate with 0.0396-inch, galvanized-steel backing. 1/4-inch grommets in corners for mounting.

H. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.3 CONCRETE BASES
A. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete."

B. Concrete: 3000-psi, 28-day compressive strength.

2.5 CONCRETE BOXES

A. Concrete Boxes: Pre-cast reinforced, size and type as shown; Christy, Brooks or approved equal. All underground boxes shall be provided with traffic grade, spring loaded, bolt-down, steel cover and McCain or equivalent vandal proof insert.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, slotted channel system components.

B. Dry Locations: Steel materials.

C. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four with, 200-lb minimum design load for each support element.

3.3 SUPPORT INSTALLATION

A. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

B. Size supports for multiple raceway or cable runs so capacity can be increased by a 25 percent minimum in the future.

C. Support individual horizontal single raceways with separate, malleable-iron pipe hangers or clamps except use spring-steel fasteners for 1-1/2-inch and smaller single raceways above suspended ceilings and for fastening raceways to slotted channel and angle supports.

D. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless coredrilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

E. Secure electrical items and their supports to building structure, using the following methods unless other fastening methods are indicated:
   1. Wood: Wood screws or screw-type nails.
2. Gypsum Board: Toggle bolts. Seal around sleeves with joint compound, both sides of wall.
3. Masonry: Toggle bolts on hollow block and expansion bolts on solid block. Seal around sleeves with mortar, both sides of wall.
4. New Concrete: Concrete inserts with machine screws and bolts.
5. Existing Concrete: Expansion bolts.
   a. Comply with AWS D1.1 for field welding.
7. Light Steel Framing: Sheet metal screws.
10. Fasteners: Select so load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 IDENTIFICATION MATERIALS AND DEVICES

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

E. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.

F. Install warning, caution, and instruction signs where required to comply with 29 CFR 1910.145, Chapter XVII, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Indoors install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

G. Install, where applicable, engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

H. Provide service description etched on cover of all underground pull boxes.

3.5 FIRESTOPPING

A. Apply firestopping to cable and raceway sleeves and other penetrations of fire-rated floor and wall assemblies to restore original undisturbed fire-resistance ratings of assemblies. Firestopping installation is specified in Division 7 Section "Through-Penetration Firestop Systems."

3.6 CONCRETE BASES
A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated.

3.7 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.8 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair, refinish and touch up disturbed finish materials and other surfaces to match adjacent undisturbed surfaces.

END OF SECTION
SECTION 26 05 19

CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.2 SUBMITTALS

A. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 CONDUCTORS AND CABLES

A. Manufacturers:
   1. Alcan Aluminum Corporation; Alcan Cable Div.
   3. General Cable Corporation.
   4. Senator Wire & Cable Company.
   5. Southwire Company.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper complying with NEMA WC 5 or 7; stranded conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

D. Conductor Insulation Types: Type THW, THHN-THWN or XHHW complying with NEMA WC 5 or 7.

2.3 CONNECTORS AND SPLICES

A. Manufacturers:
   1. AMP Incorporated/Tyco International.
   2. Hubbell/Anderson.
   3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN-THWN, single conductors in raceway.

E. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.


I. Fire Alarm Circuits: Type THHN-THWN, in raceway.

J. Class 1 Control Circuits: Type THHN-THWN, in raceway.

K. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed feeders parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26.

F. Seal around cables penetrating fire-rated elements according to Section "Through-Penetration Firestop Systems."

G. Identify and color-code conductors and cables according to Division 26 Section "Basic Electrical Materials and Methods."

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CONDUCTORS AND CABLES
H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.3 FIELD QUALITY CONTROL

A. Testing: Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION
SECTION 26 05 26

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Requirements specified in this Section may be supplemented by requirements of other Sections.

1.2 SUBMITTALS

A. Product Data: For ground rods.

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled under UL 467 as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Boggs, Inc.
   2. Copperweld Corp.
   3. Dossert Corp.
   5. Galvan Industries, Inc.
   8. Heary Brothers Lightning Protection Co.
   9. ILSCO.
   12. Lightning Master Corp.
   13. Lyneol XIT Grounding.
   15. Robbins Lightning, Inc.
   17. Superior Grounding Systems, Inc.
   18. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."

B. Equipment Grounding Conductors: Insulated with green-colored insulation.
C. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

D. Grounding Electrode Conductors: Stranded cable.

E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

F. Bare, Solid-Copper Conductors: ASTM B 3.

G. Assembly of Bare, Stranded-Copper Conductors: ASTM B 8.

H. Bare, Tinned-Copper Conductors: ASTM B 33.

I. Copper Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.

J. Copper Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

K. Tinned-Copper Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

L. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulated spacer.

M. Connectors: Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items. Exothermic-welded type, in kit form, selected per manufacturer's written instructions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.
   1. Size: 3/4 inches in diameter by 120 inches long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
   2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the indicated height above the floor.

GROUNDING AND BONDING

26 05 26 - 2
E. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

F. Equipment Grounding Conductors: Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
   1. Install insulated equipment grounding conductors in feeders.
   2. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
   3. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
   4. Air-Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
   5. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install an insulated equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
   6. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location and per Division 27.
      a. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a grounding bus per Division 27.
      b. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
   7. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing an insulated equipment grounding conductor with supply branch-circuit conductors.

G. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
   1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
   2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except as otherwise indicated. Make connections without exposing steel or damaging copper coating.

H. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

I. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers or supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

J. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp.
connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

K. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

L. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

M. Connections: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
   6. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
   7. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
   8. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
   9. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
   10. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
   11. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

N. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

O. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod.
or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

3.2 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:
1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is indicated and at service disconnect enclosure grounding terminal. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
3. Provide drawings locating each ground rod, ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results. Nominal maximum values are as follows:
   a. Equipment Rated 500 kVA and Less: 10 ohms.
   b. Equipment Rated 500 to 1000 kVA: 5 ohms.
   c. Equipment Rated More Than 1000 kVA: 3 ohms.
   e. Manhole Grounds: 10 ohms.

END OF SECTION
SECTION 26 05 29
SEISMIC FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It applies to and complements optional seismic-restraint requirements in the various electrical component Sections of these Specifications.

1.2 DEFINITIONS

A. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.

B. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independently of other structural elements during an earthquake.

1.3 SUBMITTALS

A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic-restraint component used. Include documentation of evaluation and approval of components by agencies acceptable to authorities having jurisdiction.

B. Shop Drawings: For components, physical arrangements, and installation details not defined by Drawings. Indicate materials and show calculations, design analysis, details, and layouts, signed and sealed by a professional engineer.

C. Pre-approval and Evaluation Documentation: By an agency approved by authorities having jurisdiction, showing maximum ratings of restraints.

D. Qualification data.

E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in California Building Code, unless requirements in this Section are more stringent.

B. Testing Agency Qualifications: An independent testing and inspection agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the inspection indicated.

1.5 PROJECT CONDITIONS

A. Project Seismic Design Category D and Risk Factor III as Defined in CBC.
SECTION 26 05 29

SEISMIC FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It applies to and complements optional seismic-restraint requirements in the various electrical component Sections of these Specifications.

1.2 DEFINITIONS

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B. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independently of other structural elements during an earthquake.

1.3 SUBMITTALS

A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic-restraint component used. Include documentation of evaluation and approval of components by agencies acceptable to authorities having jurisdiction.

B. Shop Drawings: For components, physical arrangements, and installation details not defined by Drawings. Indicate materials and show calculations, design analysis, details, and layouts, signed and sealed by a professional engineer.

C. Pre-approval and Evaluation Documentation: By an agency approved by authorities having jurisdiction, showing maximum ratings of restraints.

D. Qualification data.

E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in California Building Code, unless requirements in this Section are more stringent.

B. Testing Agency Qualifications: An independent testing and inspection agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the inspection indicated.

1.5 PROJECT CONDITIONS

A. Project Seismic Design Category D and Risk Factor III as Defined in CBC.
1.6 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structure, architectural features, and mechanical, fire-protection, electrical, and other building systems.

B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following with ICC or equivalent approval:
   1. Amber/Booth Company, Inc.
   2. B-Line Systems, Inc.
   3. Enico, Inc.
   4. G.S. Metals Corp.
   5. Loos & Company, Inc.
   6. Mason Industries, Inc.
   7. Powerstrut.
   8. Thomas & Betts Corp.

2.2 MATERIALS

A. Use the following materials for restraints:
   1. Indoor Dry Locations: Steel, zinc plated.
   2. Outdoors and Damp Locations: Galvanized steel.

2.3 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Strength in tension and shear of components shall be at least \( \frac{1}{2} \) the maximum seismic forces for which they are required to be designed.

B. Concrete and Masonary Anchor Bolts and Studs: Steel-expansion ICC approved wedge type.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.
2.4 SEISMIC-BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
   1. Materials for Channel: ASTM A 570, GR 33.
   3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
   4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

C. Hanger Rod Stiffeners: Slotted steel channels, installed vertically, with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated.

B. Install structural attachments as follows:
   1. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.
   2. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.
   3. Attachments to Existing Concrete: Use expansion anchors.
   4. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
   5. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
   6. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
   7. Attachments to Wood Structural Members: Install bolts through members.
   8. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

C. Install electrical equipment anchorage as follows:
   1. Anchor panelboards, motor-control centers, motor controls, switchboards, transformers, fused power-circuit devices, control, and distribution units as follows:
      a. Anchor equipment rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.
      b. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
      c. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
      d. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
      e. Torque bolts and nuts on studs to values recommended by equipment manufacturer.
D. Install seismic bracing as follows:
   1. Install bracing according to spacings and strengths indicated by approved analysis.
   2. Expansion and Contraction: Install to allow for thermal movement of braced components.
   3. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

E. Accommodation of Differential Seismic Motion: Make flexible connections in raceways, cables, wireway, cable trays, and busway where they cross expansion- and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspection agency to inspect seismic-control installation for compliance with indicated requirements.

B. Testing Agency: Engage a qualified testing and inspection agency to inspect seismic-control installation for compliance with indicated requirements.

C. Reinspection: Correct deficiencies and verify by reinspection that work complies with requirements.

D. Provide written report of tests and inspections.

END OF SECTION
D. Install seismic bracing as follows:
   1. Install bracing according to spacings and strengths indicated by approved analysis.
   2. Expansion and Contraction: Install to allow for thermal movement of braced components.
   3. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

E. Accommodation of Differential Seismic Motion: Make flexible connections in raceways, cables, wireway, cable trays, and busway where they cross expansion- and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspection agency to inspect seismic-control installation for compliance with indicated requirements.

B. Testing Agency: Engage a qualified testing and inspection agency to inspect seismic-control installation for compliance with indicated requirements.

C. Reinspection: Correct deficiencies and verify by reinspection that work complies with requirements.

D. Provide written report of tests and inspections.

END OF SECTION
SECTION 26 05 29

SEISMIC FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It applies to and complements optional seismic-restraint requirements in the various electrical component Sections of these Specifications.

1.2 DEFINITIONS

A. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.

B. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independently of other structural elements during an earthquake.

1.3 SUBMITTALS

A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic-restraint component used. Include documentation of evaluation and approval of components by agencies acceptable to authorities having jurisdiction.

B. Shop Drawings: For components, physical arrangements, and installation details not defined by Drawings. Indicate materials and show calculations, design analysis, details, and layouts, signed and sealed by a professional engineer.

C. Pre-approval and Evaluation Documentation: By an agency approved by authorities having jurisdiction, showing maximum ratings of restraints.

D. Qualification data.

E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in California Building Code, unless requirements in this Section are more stringent.

B. Testing Agency Qualifications: An independent testing and inspection agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the inspection indicated.

1.5 PROJECT CONDITIONS

A. Project Seismic Design Category D and Risk Factor III as Defined in CBC.
1.6 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structure, architectural features, and mechanical, fire-protection, electrical, and other building systems.

B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following with ICC or equivalent approval:
   1. Amber/Booth Company, Inc.
   2. B-Line Systems, Inc.
   3. Erie, Inc.
   4. GS Metals Corp.
   5. Loos & Company, Inc.
   6. Mason Industries, Inc.
   7. Powerstrut.
   8. Thomas & Betts Corp.

2.2 MATERIALS

A. Use the following materials for restraints:
   1. Indoor Dry Locations: Steel, zinc plated.
   2. Outdoors and Damp Locations: Galvanized steel.

2.3 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Strength in tension and shear of components shall be at least twice the maximum seismic forces for which they are required to be designed.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion ICC approved wedge type.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.
2.4 SEISMIC-BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch- thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
   1. Materials for Channel: ASTM A 570, GR 33.
   3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
   4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

C. Hanger Rod Stiffeners: Slotted steel channels, installed vertically, with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated.

B. Install structural attachments as follows:
   1. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.
   2. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.
   3. Attachments to Existing Concrete: Use expansion anchors.
   4. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
   5. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
   6. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
   7. Attachments to Wood Structural Members: Install bolts through members.
   8. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

C. Install electrical equipment anchorage as follows:
   1. Anchor panelboards, motor-control centers, motor controls, switchboards, transformers, fused power-circuit devices, control, and distribution units as follows:
      a. Anchor equipment rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.
      b. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
      c. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
      d. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
      e. Torque bolts and nuts on studs to values recommended by equipment manufacturer.
D. Install seismic bracing as follows:
   1. Install bracing according to spacings and strengths indicated by approved analysis.
   2. Expansion and Contraction: Install to allow for thermal movement of braced components.
   3. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

E. Accommodation of Differential Seismic Motion: Make flexible connections in raceways, cables, wireway, cable trays, and busway where they cross expansion- and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspection agency to inspect seismic-control installation for compliance with indicated requirements.

B. Testing Agency: Engage a qualified testing and inspection agency to inspect seismic-control installation for compliance with indicated requirements.

C. Reinspection: Correct deficiencies and verify by reinspection that work complies with requirements.

D. Provide written report of tests and inspections.

END OF SECTION
SECTION 26 13 00

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 SUBMITTALS
A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets indicated.

1.3 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING
A. Manufacturers:
   1. AFC Cable Systems, Inc.
   2. Alflex Inc.
   3. Anamet Electrical, Inc.; Anaconda Metal Hose.
   4. Electri-Flex Co.
   5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
   6. LTV Steel Tubular Products Company.
   7. Manhattan/CDT/Cole-Flex.
   8. O-Z Gedney; Unit of General Signal.
   9. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. EMT and Fittings: ANSI C80.3.
   1. Fittings: Compression type.

F. FMC: Aluminum.
G. LFMC: Flexible steel conduit with PVC jacket.
H. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers:
   2. Anamet Electrical, Inc.; Anaconda Metal Hose.
   3. Arno Corp.
   4. Cantex Inc.
   7. ElecSYS, Inc.
   8. Electri-Flex Co.
   9. Lamson & Sessions; Carlon Electrical Products.
   10. Manhattan/CDT/Cole-Flex.
   11. RACO; Division of Hubbell, Inc.
   12. Spiralduct, Inc./AFC Cable Systems, Inc.

B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
   1. Manufacturers:
      a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).
      b. Thomas & Betts Corporation.
      d. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
   1. Manufacturers:
      b. Enduro Composite Systems.
      c. Hubbell, Inc.; Wiring Device Division.
      d. Lamson & Sessions; Carlon Electrical Products.
      e. Panduit Corp.
      g. Wiremold Company (The); Electrical Sales Division.

C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:
   1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. Emerson/General Signal; Appleton Electric Company.
   3. Erickson Electrical Equipment Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

I. Concrete Boxes: Pre-cast reinforced, size and type as shown; Christy, Brooks or approved equal. All underground boxes shall be provided with traffic grade, spring loaded, bolt-down, steel cover.

2.6 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components provide manufacturer's standard prime-coat finish ready for field painting.

2.7 FIRESTOPPING FOR LOW VOLTAGE SLEEVES

A. Firestop Pillows: STI SpecSeal® Brand re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag, the following products are acceptable:

B. Fire Rated Cable Pathways: STI EZ-PATH™ Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
   1. Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:
   1. Exposed: Rigid steel or IMC.
   2. Concealed: Rigid steel or IMC.
   3. Underground, Single Run: RNC.
   4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R.
8. Backfill materials per civil site requirements.

B. Indoors:
1. Exposed: EMT.
2. Concealed: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
   a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
3. For Outdoor Use – conduit hub, NEMA 4 for conduit connection/terminating to cabinet/panel/boxes.
4. All fittings to be steel compression type with insulated throat.
5. All connectors to be steel. Die cast connectors are not acceptable.

E. Do not install aluminum conduits embedded in or in contact with concrete.

3.2 INSTALLATION
A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26 Section "Basic Electrical Materials and Methods."

D. Install temporary closures to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
1. Install concealed raceways with a minimum of bends in shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

J. Join raceways with fittings designed and approved for that purpose and make joints tight.
1. Use insulating bushings to protect conductors on all raceways 2" and larger.

K. Tighten set screws of threadless fittings with suitable tools.

L. Terminations:
1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

N. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

O. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

Q. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

R. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
S. Set floor boxes level and flush with finished floor surface.

T. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION
SECTION 26 24 20

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details for types other than NEMA 250, Type 1.
      b. Bus configuration, current, and voltage ratings.
      c. Short-circuit current rating of panelboards and overcurrent protective devices.
      d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   2. Wiring Diagrams: Power, signal, and control wiring.
   3. Field quality-control test reports.
   4. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
      a. Square D is preferred manufacturer.
      c. Siemens Energy & Automation, Inc.

2.2 MANUFACTURED UNITS

A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1.
   1. Rated for environmental conditions at installed location.
      a. Outdoor Locations: NEMA 250, Type 3R.
c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

B. Phase and Ground Buses: Hard-drawn copper, 98 percent conductivity.

C. Conductor Connectors: Suitable for use with conductor material.
   1. Ground Lugs and Bus Configured Terminators: Compression type.

D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices. Provide 20% space in all panelboards.

F. Branch Overcurrent Protective Devices:
   1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
   2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

G. Panelboard Short-Circuit Rating:
   1. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.3 DISTRIBUTION PANELBOARDS

A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

B. Main Overcurrent Protective Devices: Circuit breaker.

C. Branch Overcurrent Protective Devices:
   1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
   2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units. No tie-handle allowed for multi-pole breakers.

B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
   2. GFCI Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity.
   3. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
a. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
b. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
c. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components for all NEMA 3R panelboards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Work."

C. Mount top of trim 74 inches above finished floor, unless otherwise indicated.

D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Install overcurrent protective devices and controllers.
   1. Set field-adjustable switches and circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

H. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Basic Electrical Materials and Methods."

I. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

J. Ground equipment according to Division 26 Section "Grounding and Bonding."

K. Connect wiring according to Division 26 Section "Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:
1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION
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WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Single and duplex receptacles, ground-fault circuit interrupters.
   3. Device wall plates.
   4. Floor service outlets, poke-through assemblies and multioutlet assemblies.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Wiring Devices:
      b. Eagle Electric Manufacturing Co., Inc.
      c. Hubbell Incorporated; Wiring Device-Kellems.
      d. Leviton Mfg. Company Inc.
         e. Pass & Seymour/Legrand; Wiring Devices Div.

   2. Multioutlet Assemblies:
      a. Hubbell Incorporated; Wiring Device-Kellems.
      b. Wiremold Company (The).

   3. Poke-Through, Floor Service Outlets and Telephone/Power Poles:
      a. Hubbell Incorporated; Wiring Device-Kellems.
      b. Pass & Seymour/Legrand; Wiring Devices Div.
      c. Square D/Groupe Schneider NA.
      d. Thomas & Betts Corporation.
      e. Wiremold Company (The).
2.2 RECEPTACLES

A. Straight-Blade and Locking Receptacles: Heavy-Duty grade.

B. Straight-Blade Receptacles: Hospital grade.

C. GFCI Receptacles: Straight blade, non-feed-through type, Hospital or Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch deep outlet box without an adapter.

2.3 SWITCHES


B. Snap Switches: Heavy-Duty grade, quiet type.

C. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
   2. Receptacle: NEMA WD 6, Configuration 5-20R.

D. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
   1. Control: Continuously adjustable slider; with single-pole or three-way switching to suit connections.
   2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable rotary knob, toggle switch, or slider; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; and 5-inch wire connecting leads.
   3. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.4 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces:
      a. 0.035-inch thick, satin-finished stainless steel.
   4. Material for Wet Locations: Cast aluminum with spring-loaded, lockable, lift cover, and listed and labeled for use in "wet locations."

2.5 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, solid brass with satin finish.

D. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: See telecommunication specifications for requirements.
F. Wiremold RFB4-4DB series complete with brackets, devices, corresponding covers and hardware.

2.6 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
   1. Service Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks.
   2. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
   3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
   4. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
   5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors; and a minimum of four, 4-pair, Category 6 voice and data communication cables.

2.7 MULTIOUTLET ASSEMBLIES

A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: PVC.

C. Wire: No. 12 AWG.

2.8 FINISHES

A. Color:
   1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Install wall dimmers to achieve indicated rating after derating for ganging.

C. Install unshared neutral conductors on line and load side of dimmers.

D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.

E. Remove wall plates and protect devices and assemblies during painting.

F. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Basic Electrical Materials and Methods."
   1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

WIRING DEVICES
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2. Submit same for approval.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:
   1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
   2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

   END OF SECTION
SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
   1. Fusible switches.
   2. Nonfusible switches.
   4. Enclosures.

1.2 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   4. Square D/Group Schneider.

B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type GD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 600 A and Smaller: NEMA KS 1, Type GD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open (required for all disconnects located downstream of Variable frequency Drives)

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:
1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
4. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.

C. Molded-Case Circuit-Breaker Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Basic Electrical Materials and Methods," and concrete materials and installation requirements are specified.

C. Comply with applicable portions of NEC 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
D. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

E. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Work."

F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

G. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Basic Electrical Materials and Methods."

3.2 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:
   1. Inspect mechanical and electrical connections.
   2. Verify switch and relay type and labeling verification.
   3. Verify rating of installed fuses.

B. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION
SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Interior lighting fixtures with lamps and ballasts.
   2. Emergency lighting units.
   3. Exit signs.
   4. Accessories, including LED fixture dimmers, occupancy sensors and lighting fixture retrofitting.

1.2 SUBMITTALS

A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, and finishes. Clearly identify ballast(s) and lamp(s) for each lighting fixture.

B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.4 Definitions

A. PMMA – Poly Methyl Methacrylate

B. CCT – Correlated Color Temperature

C. CRI – Color Rated Index

D. UL – Underwriters Laboratory

E. NRTL – Nationally Recognized Testing Laboratories

F. LED – Light Emitting Diode


H. L70 – Reported Life of LED lumen maintenance (L, in hrs.) 70% lumen maintenance

I. ASTM – American Society for Testing and Materials
J. IBEW – International Brotherhood of Electrical Workers
K. IESNA – Illuminating Engineering Society of North America
L. LM-80 – IESNA approved method of measuring Lumen Depreciation of LED Light Sources
M. LM-79-08 – Approved Method for the Electrical and Photometric Measurements of Solid-Sate Lighting Products or LEDs.
N. PFC – Power Factor Correction
O. PCI – Powder Coating Institute

1.5 Performance Requirements

A. All lighting products as herein after specified shall be a standard product of the manufacturer, and shall consist of components that will be readily available for future replacement for period of (3) years.

B. Provide all lighting fixtures as shown complete with all hardware necessary to install fixtures.

C. Luminaire shall be free of light leaks.

D. Luminaire suitable for use in max. ambient temperatures of 35°C (95°F) and minimum ambient operating temperature of -20°C (-4°F) for standard, 0-10V (DM/DML) and Dali dimming driver (DMD). The Minimum ambient operating temperature for the LUTRON driver (DC3/DCE) options is 0°C (32°F).

E. LED package shall be designed around the lumen maintenance of 87% at 60,000 hrs. and is to be expected to achieve L70 at 100,000 hrs.

F. All wiring shall be adequate for LEDs, Driver and Voltage requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 DIRECT LIGHT ENGINE:

A. High efficacy LED light engine equipped with brand-name LEDs available in outputs of 100%, 85%, 70% and 55%.

1. 1L35 (100%)

2. 1L30 (85%) Requires Dimming option

3. 1L25 (70%) Requires Dimming option

4. 1L20 (55%) Requires Dimming option

a. All Drivers are Electronic Class 2, high efficiency with the following PFC:

1) Standard Non-Dimming Driver (PFC>0.95).
2.3 INDIRECT LIGHT ENGINE:

A. High efficacy LED light engine equipped with brand-name LEDs available in outputs of 100%, 85%, 70% and 55%.

1. 1L35 (100%)
2. 1L30 (85%) Requires Dimming option
3. 1L25 (70%) Requires Dimming option
4. 1L20 (55%) Requires Dimming option
   b. All Drivers are Electronic Class 2, high efficiency with the following PFC:
      1) Standard Non-Dimming Driver (PFC>0.95).
      2) Optional 0-10v, & Dali Dimming Drivers (PFC>0.90).
      3) Optional Lutron 3-wire and Eco-System Dimming Drivers (PFC 0.99)

2.4 CCT:

A. CCT packages shall be available in 2700K, 3000K, 3500K and 4000K. CCT tolerances are to be kept within a 3-step MacAdam ellipse and are to maintain a Min CRI of 80.

1. 27 (2700K)
2. 30 (3000K)
3. 35 (3500K)
4. 40 (4000K)

2.5 DIRECT SHIELDING:

A. All Shielding’s shall be extruded impact resistant PMMA. 1. LW (LED optimized white lens)

2.6 INDIRECT SHIELDING:

A. All Shielding’s shall be extruded impact resistant PMMA.
   1. LW (LED optimized white lens)

2.7 LAMP BALLASTS

A. Description: Include the following features, unless otherwise indicated:

1. Designed for type and quantity of lamps indicated at full light output except for emergency lamps powered by in-fixture battery-packs.
2. Externally fused with slow-blow type rated between 2.65 and 3.0 times the line current.
3. Warranted for 5 years to include replacement ballasts and labor cost, plus lamp warranty for at least 2 years for lamps used with ballast.
B. LED lamps shall include following features:
   1. L.E.D. 3500K - Philips, CREE or approved equal.
   2. Comply with NEMA C82.11.
   3. Normal Light Output (NLO) BF 0.87.
   4. Sound Rating: A.
   5. Total harmonic distortion rating of less than 20 percent according to NEMA C82.11.
   6. Transient Voltage Protection: IEEE C62.41, Category A.
   7. Listed class P automatic reset thermal protection.
   8. Lamp Current Crest Factor: Less than 1.7

C. Ballasts for dimmer-controlled fixtures shall comply with general and fixture-related requirements above for electronic ballasts and the following features:
   1. Dimming Range: 100 to 5 percent of rated lamp lumens.
   2. Ballast Input Watts: Can be reduced to 20 percent of normal.
   3. Compatibility: Certified by manufacturer for use with specific dimming system indicated.

2.8 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
   1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

2.9 EMERGENCY LIGHTING UNITS

A. General: Self-contained units complying with UL 924.
   1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.

INTERIOR LIGHTING
26 51 00 - 4
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

4. Wire Guard: Where indicated, heavy-chrome-plated wire guard protects lamp heads or fixtures.

5. Integral Time-Delay Relay: Holds unit on for fixed interval when power is restored after an outage; time delay permits high-intensity-discharge lamps to restrike and develop adequate output.

2.10 EMERGENCY LIGHTING FIXTURES

A. Internal Type: Self-contained, modular, battery-inverter unit factory mounted within fixture body. Comply with UL 924.

   1. Emergency Connection: Operate one lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.

   2. Night Light Connection: Operate one lamp continuously.

   3. Test Switch and Light-Emitting-Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

   4. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.

   5. Charger: Fully automatic, solid-state, constant-current type.

2.11 LED LAMPS

A. L.E.D. /3500K - Philips, CREE or approved equal.

2.12 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Basic Electrical Materials and Methods" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.


E. Wires For Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
2.13 LIGHTING CONTROL DEVICES

A. Dimming Ballast Controls: Sliding-handle type with on/off control; compatible with ballast and having light output and energy input over the full dimming range.

B. Light Level Sensor: Detect changes in ambient lighting level and provide dimming range of 20 to 100 percent in response to change.
   2. Adjustable Ambient Detection Range: 10 to 100 fc minimum

C. Occupancy Sensors: Adjustable sensitivity and off delay time range of 5 to 15 minutes.
   1. Device Color:
   2. Occupancy detection indicator.
   3. Ultrasonic Sensors: Crystal controlled with circuitry that causes no detection interference between adjacent sensors.
   4. Infrared Sensors: With daylight filter and lens to afford coverage applicable to space to be controlled.
   5. Combination Sensors: Ultrasonic and infrared sensors combined.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
   1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from fixture corners.
   2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
   4. Install at least two independent support rods or wires from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Fixture Support: As follows:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging. Pendant fixtures shall be free to swing a minimum of 45 degrees from the vertical in all directions without contacting any obstructions. Otherwise, seismic restraints are required.

3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.


D. Air-Handling Fixtures: Install with dampers closed and ready for adjustment.

E. Adjust aimable fixtures to provide required light intensities.

F. Occupancy sensor and daylighting sensor placement review by factory representative is required before installing sensors.

3.2 COMMISSIONING

A. All electrical power and lighting controls will be commissioned per the requirements of Section 01 91 13, Commissioning Requirements. Contractor is to provide a factory representative to start-up, test and commission all lighting controls.

END OF SECTION
SECTION 26 61 00

LIGHTING CONTROL SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Digital Lighting Controls
2. Relay Panels
3. Emergency Lighting Control (if applicable)

B. Related Sections:

1. Section [26 27 26 - Wiring Devices:]
2. Section [26 51 00 – Interior Lighting Fixtures, Lamps, and Ballasts:]
3. Section [23 09 00 – Integrated Automation] Building integrator shall provide integration of the lighting control system with Building Automation Systems.
4. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section
5. Electrical Sections, including wiring devices, apply to the work of this Section.

C. Control Intent – Control Intent includes, but is not limited to:

1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
2. Initial sensor and switching zones
3. Initial time switch settings
4. Task lighting and receptacle controls
5. Emergency Lighting control (if applicable)

1.2 REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
B. Underwriter Laboratories of Canada (ULC)
C. International Electrotechnical Commission (IEC)
D. International Organization for Standardization (ISO)
E. National Electrical Manufacturers Association (NEMA)
F. WD1 (R2005) - General Color Requirements for Wiring Devices.

G. Underwriters Laboratories, Inc. (UL)
   1. 20 – Plug Load Controls
   2. 508 - Industrial Controls
   4. 924 – Emergency Lighting

1.3 SYSTEM DESCRIPTION & OPERATION

A. The Lighting Control and Automation system as defined under this section covers the following equipment:

1. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.

2. Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.

3. Handheld remotes for personal control – One-button dimming, two-button on/off, or five-button scene remotes provide control using infrared communications. Remote may be configured in the field to control selected loads or scenes without special tools.

4. Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications can provide switching, bi-level, tri-level or dimming control for daylight harvesting.

5. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.


7. Configuration Tools – Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device/room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow bi-directional communication of room variables and occupancy sensor settings. Computer software also customizes room settings.

8. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.

9. Digital Lighting Management (DLM) segment network – Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded,) to connect multiple DLM local networks for centralized control.
10. Network Bridge – provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS) and automatically creates BACnet objects representative of connected devices.

11. Segment Manager – provides web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.

12. Programming and Configuration software – Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.

13. LMCP Digital Lighting Management Relay Panel – provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS).

14. Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

1.4 LIGHTING CONTROL APPLICATIONS

A. Unless relevant provisions of the applicable local Energy Codes are more stringent, provide a minimum application of lighting controls as follows:

1. Space Control Requirements – Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.

2. Bi-Level Lighting – Provide multi-level controls in all spaces except toilet rooms, storerooms, library stacks, or applications where variable dimming is used.

3. Task Lighting / Plug Loads – Provide automatic shut off of non essential plug loads and task lighting in all spaces except toilet rooms and storerooms. Provide Automatic-ON of plug loads whenever spaces are occupied. For spaces with multiple occupants a single shut off consistent with the overhead lighting may be used for the area.

4. Daylit Areas – Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:

   a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
b. Daytime setpoints for total ambient illumination (combined daylight and
   electric light) levels that initiate dimming shall be programmed in compli-
   ance with relevant local building energy codes.

c. Multiple-leveled switched daylight harvesting controls may be utilized for
   areas marked on drawings.

d. Provide smooth and continuous daylight dimming for areas marked on
   drawings. Daylighting control system may be designed to turn off electric
   lighting when daylight is at or above required lighting levels, only if sys-
   tem functions to turn lamps back on at dimmed level, rather than turning
   full-on prior to dimming.

5. Conference, meeting, training, auditoriums, and multipurpose rooms shall have con-
   trols that allow for independent control of each local control zone. Rooms larger than
   300 square feet shall instead have at least four (4) pre-set lighting scenes unless oth-
   erwise specified. Occupancy / vacancy sensors shall be provided to extinguish all
   lighting in the space. Spaces with up to four moveable walls shall include controls
   that can be reconfigured when the room is partitioned.

1.5 SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the
   same time as a package.

B. Shop Drawings:

1. Composite wiring and/or schematic diagram of each control circuit as proposed to be
   installed.

2. Show exact location of all digital devices, including at minimum sensors, room con-
   trollers, and switches for each area on reflected ceiling plans. (Contractor must pro-
   vide AutoCAD format reflected ceiling plans.)

3. Provide room/area details including products and sequence of operation for each
   room or area. Illustrate typical acceptable room/area connection topologies.

4. Network riser diagram including floor and building level details. Include network cable
   specification and end-of-line termination details, if required. Illustrate points of con-
   nection to integrated systems. Coordinate integration with mechanical and/or other
   trades.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Include data for each device which:

1. Indicates where sensor is proposed to be installed.

2. Prove that the sensor is suitable for the proposed application.

1.6 QUALITY ASSURANCE

1.7 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   
   1. Ambient temperature: 0°F to 40°F C (32°F to 104°F F).
   
   2. Relative humidity: Maximum 90 percent, non-condensing.

1.8 WARRANTY

A. Provide a five year limited manufacturer’s warranty on all room control devices and panels.

1.9 MAINTENANCE

A. Spare Parts:
   
   1. Provide 10% spares of each product to be used for maintenance for wall switches, dimmer switches and controllers.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:
   
   1. WattStopper
      
      a. System: Digital Lighting Management (DLM)


B. Substitutions: [If Permitted]
   
   1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.

   2. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power and control wiring) with deviations from the original design highlighted for review and approval prior to rough-in.

2.2 DIGITAL LIGHTING CONTROLS

A. Furnish the Company’s system which accommodates the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories which suit the lighting and electrical system parameters.
2.3 DIGITAL WALL SWITCH OCCUPANCY SENSORS

A. Wallbox mounted passive infrared PIR or dual technology (passive infrared and ultrasonic) digital occupancy sensor with 1 or 2 switch buttons.

B. Digital Occupancy Sensors shall provide scrolling LCD display for digital calibration and electronic documentation. Features include the following:

1. Digital calibration and pushbutton configuration for the following variables:
   a. Sensitivity – 0-100% in 10% increments
   b. Time delay – 1-30 minutes in 1 minute increments
   c. Test mode – Five second time delay
   d. Detection technology – PIR, Dual Technology activation and/or re-activation.
   e. Walk-through mode
   f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.

2. Programmable control functionality including:
   a. Each sensor may be programmed to control specific loads within a local network.
   b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
   c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.
   d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
      i. Ultrasonic and Passive Infrared
      ii. Ultrasonic or Passive Infrared
      iii. Ultrasonic only
      iv. Passive Infrared only

3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.

4. Two RJ-45 ports for connection to DLM local network.

5. Two-way infrared (IR) transceiver to allow remote programming through handheld configuration tool and control by remote personal controls.

6. Device Status LEDs including:
a. PIR detection
b. Ultrasonic detection
c. Configuration mode
d. Load binding

7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.

8. Assignment of local buttons to specific loads within the room without wiring or special tools


10. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.

C. BACnet object information shall be available for the following objects:

1. Detection state
2. Occupancy sensor time delay
3. Occupancy sensor sensitivity, PIR and Ultrasonic
4. Button state
5. Switch lock control
6. Switch lock status

D. Units shall not have any dip switches or potentiometers for field settings.

E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

F. Two-button wall switch occupancy sensors, when connected to a single relay dimming room controller, shall operate in the following sequence as a factory default:

1. Left button
   a. Press and release - Turn load on
   b. Press and hold - Raise dimming load

2. Right button
   a. Press and release - Turn load off
   b. Press and hold - Lower dimming load

G. Low voltage momentary pushbuttons shall include the following features:
1. Load/Scene Status LED on each switch button with the following characteristics:
   a. Bi-level LED
   b. Dim locator level indicates power to switch
   c. Bright status level indicates that load or scene is active

2. The following button attributes may be changed or selected using a wireless configuration tool:
   a. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
   b. Individual button function may be configured to Toggle, On only or Off only.
   c. Individual scenes may be locked to prevent unauthorized change.
   d. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
   e. Ramp rate may be adjusted for each dimmer switch.
   f. Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.

H. WattStopper part numbers: LMPW, LMDW. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.4 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor.

B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:

   1. Digital calibration and pushbutton configuration for the following variables:
      a. Sensitivity – 0-100% in 10% increments
      b. Time delay – 1-30 minutes in 1 minute increments
      c. Test mode – Five second time delay
      d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
      e. Walk-through mode
      f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.

2. Programmable control functionality including:
a. Each sensor may be programmed to control specific loads within a local network.

b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.

c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.

d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
   i. Ultrasonic and Passive Infrared
   ii. Ultrasonic or Passive Infrared
   iii. Ultrasonic only
   iv. Passive Infrared only

3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.

4. One or two RJ-45 port(s) for connection to DLM local network.

5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.

6. Device Status LEDs, which may be disabled for selected applications, including:
   a. PIR detection
   b. Ultrasonic detection
   c. Configuration mode
   d. Load binding

7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.


9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:

   1. Detection state
   2. Occupancy sensor time delay
   3. Occupancy sensor sensitivity, PIR and Ultrasonic
C. Units shall not have any dip switches or potentiometers for field settings.
D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
E. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.5 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:

1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.

2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.

3. Configuration LED on each switch that blinks to indicate data transmission.

4. Load/Scene Status LED on each switch button with the following characteristics:
   a. Bi-level LED
   b. Dim locator level indicates power to switch
   c. Bright status level indicates that load or scene is active

5. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.

6. Programmable control functionality including:
   a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
   b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.

7. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:

1. Button state
2. Switch lock control
3. Switch lock status

C. Two RJ-45 ports for connection to DLM local network.
D. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.

E. The following switch attributes may be changed or selected using a wireless configuration tool:

1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).

2. Individual button function may be configured to Toggle, On only or Off only.

3. Individual scenes may be locked to prevent unauthorized change.

4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.

5. Ramp rate may be adjusted for each dimmer switch.

6. Switch buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.


2.6 HANDHELD REMOTE CONTROLS

A. Battery-operated handheld devices in 1, 2 and 5 button configurations for remote switching or dimming control. Remote controls shall include the following features:

1. Two-way infrared (IR) transceiver for line of sight communication with DLM local network within up to 30 feet.

2. LED on each button confirms button press.

3. Load buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.

4. Inactivity timeout to save battery life.

B. A wall mount holster and mounting hardware shall be included with each remote control

C. WattStopper part numbers: LMRH-101, LMRH-102, LMRH-105.

2.7 DIGITAL PARTITION CONTROLS
A. Partition controls shall enable manual or automatic coordination of lighting controls in flexible spaces with up to four moveable walls by reconfiguring the connected digital switches and occupancy sensors.

B. Four-button low voltage pushbutton switch for manual control.
   1. Two-way infrared (IR) transceiver for use with configuration remote control.
   2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
   3. Configuration LED on each switch that blinks to indicate data transmission.
   4. Each button represents one wall; Green button LED indicates status.
   5. Two RJ-45 ports for connection to DLM local network.

C. Contact closure interface for automatic control via input from limit switches on movable walls (by others).
   1. Operates on Class 2 power supplied by DLM local network.
   2. Includes 24VDC output and four input terminals for maintained third party contract closure inputs.
      a. Input max. sink/source current: 1-5mA
      b. Logic input signal voltage High: >18VDC
      c. Logic input signal voltage Low: <2VDC
   3. Four status LEDs under hinged cover indicate if walls are open or closed; supports LMPS-104 as remote status indicator.
   4. Two RJ-45 ports for connection to DLM local network.
   5. WattStopper part number: LMIO-102

2.8 DIGITAL DAYLIGHTING SENSORS

A. Digital daylighting sensors shall work with room controllers to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to a room controller. Daylighting sensors shall be interchangeable without the need for rewiring.
   1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.

3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone.

B. Digital daylighting sensors shall include the following features:

1. The sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode’s spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.

2. Sensor light level range shall be from 1-6,553 footcandles (fc).

3. The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).

4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the “ON Setpoint” and the “OFF Setpoint” that will prevent the lights from cycling excessively after they turn off.

5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.

6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.

7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.

8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.

9. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.

10. Configuration LED status light on device that blinks to indicate data transmission.

11. Status LED indicates test mode, override mode and load binding.

12. Recessed switch on device to turn controlled load(s) ON and OFF.

13. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:

   a. Light level
   b. Day and night setpoints
   c. Off time delay
   d. On and off setpoints
e. Up to three zone setpoints
f. Operating mode – on/off, bi-level, tri-level or dimming

14. One RJ-45 port for connection to DLM local network.

15. A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62" thickness (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62"-1.25" thickness (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.

16. Any load or group of loads in the room can be assigned to a daylighting zone

17. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).

18. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.

C. Closed loop digital photosensors shall include the following additional features:

1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.

2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.

3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.

4. WattStopper Product Number: LMLS-400, LMLS-400-L.

D. Open loop digital photosensors shall include the following additional features:

1. An internal photodiode that measures light in a 60-degree angle cutting off the unwanted light from the interior of the room.

2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.

3. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.

4. WattStopper Product Number: LMLS-500, LMLS-500-L.

E. Dual loop digital photosensors shall include the following additional features:
1. Close loop portion of dual loop device must have an internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from sources outside of this cone.

2. Open loop portion of dual loop device must have an internal photodiode that can measure light in a 60 degree angle, cutting off the unwanted light from the interior of the room.

3. Automatically establishes application-specific set-points following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of load.

4. Device must reference closed loop photosensor information as a base line reference. The device must be able to analyze the open loop photosensor information to determine if an adjustment in light levels is required.

5. Device must be able to automatically commission setpoints each night to provide adjustments to electrical lighting based on changes in overall lighting in the space due to changes in reflectance within the space or changes to daylight contribution based on seasonal changes.

6. Device must include extendable mounting arm to properly position sensor within a skylight well.

7. WattStopper product number LMLS-600

2.9 DIGITAL ROOM CONTROLLERS AND PLUG-LOAD CONTROLLERS

A. Digital controllers for lighting and plug loads automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room and plug load controllers shall be provided to match the room lighting and plug load control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.

2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf.

3. Multiple room controllers connected together in a local network must automatically prioritize each room controller, without requiring any configuration or setup, so that loads are sequentially assigned using room controller device ID's from highest to lowest.

4. Device Status LEDs to indicate:
   a. Data transmission
   b. Device has power
   c. Status for each load
   d. Configuration status
5. Quick installation features including:
   a. Standard junction box mounting
   b. Quick low voltage connections using standard RJ-45 patch cable

6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
   a. Turn on to 100%
   b. Remain off
   c. Turn on to last level

7. Each load shall be configurable to operate in the following sequences based on occupancy:
   a. Auto-on/Auto-off (Follow on and off)
   b. Manual-on/Auto-off (Follow off only)

8. The polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.

9. BACnet object information shall be available for the following objects:
   a. Load status
   b. Electrical current
   c. Total watts per controller
   d. Schedule state – normal or after-hours
   e. Demand response control and cap level
   f. Room occupancy status
   g. Total room lighting and plug loads watts
   h. Total room watts/sq ft
   i. Force on/off all loads

10. UL 2043 plenum rated

11. Manual override and LED indication for each load

12. Dual voltage (120/277 VAC, 60 Hz), or 347 VAC, 60 Hz (selected models only). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming); 347 volt models rated for 15A total load; plug load controllers carry application-specific UL 20 rating for receptacle control.

13. Zero cross circuitry for each load

14. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.

B. On/Off Room Controllers shall include:
1. One or two relay configuration
2. Efficient 150 mA switching power supply
3. Three RJ-45 DLM local network ports with integral strain relief and dust cover
4. WattStopper product numbers: LMRC-101, LMRC-102

C. On/Off/Dimming enhanced Room Controllers shall include:

1. Real time current monitoring
2. Multiple relay configurations
   a. One, two or three relays (LMRC-21x series)
   b. One or two relays (LMRC-22x series)
3. Efficient 250 mA switching power supply
4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
5. One dimming output per relay
   a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
   b. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-22x series)
   c. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
   d. The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
   e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
   f. Calibration and trim levels must be set per output channel.
   g. Devices that set calibration or trim levels per controller are not acceptable.
   h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

6. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
7. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
8. The following dimming attributes may be changed or selected using a wireless configuration tool:
   b. Establish preset level for each load from 0-100%
   c. Set high and low trim for each load
   d. Set lamp burn in time for each load up to 100 hours

9. Override button for each load provides the following functions:
   b. Press and release for on/off control
   c. Press and hold for dimming control

10. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMRC-221, LMRC-222

D. Plug Load Room Controllers shall include:
   1. One relay configuration with additional connection for unswitched load
   2. Configurable additive time delay to extend plug load time delay beyond occupancy sensor time delay (e.g. a 10 minute additive delay in a space with a 20 minute occupancy sensor delay ensures that plug loads turn off 30 minutes after the space is vacated).
   3. Factory default operation is Auto-on/Auto-off, based on occupancy
   4. Real time current monitoring of both switched and un-switched load (LMPL-201 only)
   5. Efficient switching power supply
      a. 150mA (LMPL-101)
      b. 250mA (LMPL-201)
   6. RJ-45 DLM local network ports
      a. Three RJ-45 ports (LMPL-101)
      b. Four RJ-45 ports (LMPL-201)

2.10 DLM LOCAL NETWORK (Room Network)

A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.

B. Features of the DLM local network include:
   1. Plug n’ Go® automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
   2. Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
3. Push n' Learn® configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.

4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

C. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.

D. If manufacturer’s pre-terminated Cat5e cables are not used for the installation, the contractor is responsible for testing each cable following installation and supplying manufacturer with test results.

E. WattStopper Product Number: LMRJ-Series

2.11 DLM SEGMENT NETWORK (Room to Room Network)

A. The segment network shall be a linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms) and LMCP relay panels for centralized control.

1. Each connected DLM local network shall include a single network bridge (LMBC-300), and the network bridge is the only room-based device that is connected to the segment network.

2. Network bridges, relay panels and segment managers shall include terminal blocks, with provisions for separate “in” and “out” terminations, for segment network connections.

3. The segment network shall utilize 1.5 twisted pair, shielded, cable supplied by the lighting control manufacturer. The maximum cable run for each segment is 4,000 feet. Conductor-to-conductor capacitance of the twisted pair shall be less than 30 pF/ft and have a characteristic impedance of 120 Ohms.

4. Network signal integrity requires that each conductor and ground wire be correctly terminated at every connected device.

5. Substitution of manufacturer-supplied cable must be pre-approved: Manufacturer will not certify network reliability, and reserves the right to void warranty, if non-approved cable is installed, and if terminations are not completed according to manufacturer’s specific requirements.

6. Segment networks shall be capable of connecting to BACnet-compliant BAS (provided by others) either directly, via MS/TP, or through NB-ROUTERS, via BACnet/IP or BACnet/Ethernet. Systems whose room-connected network infrastructure require gateway devices to provide BACnet data to a BAS are unacceptable.

B. WattStopper Product Number: LM-MSTP, LM-MSTP-DB
2.12 CONFIGURATION TOOLS

A. A wireless configuration tool facilitates optional customization of DLM local networks using two-way infrared communications, while PC software connects to each local network via a USB interface.

B. Features and functionality of the wireless configuration tool shall include but not be limited to:

1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.

2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.

3. Must be able to read and modify parameters for room controllers, occupancy sensors, wall switches, daylighting sensors, network bridges and relay panels, and identify room devices by type and serial number.

4. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.

5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.

6. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.

7. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.

8. Verify status of building level network devices.

C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

2.13 NETWORK BRIDGE

A. The network bridge module connects a DLM local network to a BACnet-compliant segment network for communication between rooms, relay panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. The network bridge shall use industry standard BACnet MS/TP network communication and an optically isolated EIA/TIA RS-485 transceiver.

1. The network bridge shall be provided as a separate module connected on the local network through an available RJ-45 port.

2. Provide Plug n’ Go operation to automatically discover room devices connected to the local network and make all device parameters visible to the segment manager via the segment network. No commissioning shall be required for set up of the network bridge on the local network.
3. The network bridge shall automatically create standard BACnet objects for selected room device parameters to allow any BACnet-compliant BAS to include lighting control and power monitoring features as provided by the DLM room devices on each local network. BACnet objects will be created for the addition or replacement of any given in-room DLM device for the installed life of the system. Products requiring that an application-specific point database be loaded to create or map BACnet objects are not acceptable. Systems not capable of providing BACnet data for control devices via a dedicated BACnet Device ID and physical MS/TP termination per room are not acceptable. Standard BACnet objects shall be provided as follows:

   a. Read/write the normal or after hours schedule state for the room
   b. Read the detection state of each occupancy sensor
   c. Read the aggregate occupancy state of the room
   d. Read/write the On/Off state of loads
   e. Read/write the dimmed light level of loads
   f. Read the button states of switches
   g. Read total current in amps, and total power in watts through the room controller
   h. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings
   i. Activate a preset scene for the room
   j. Read/write daylight sensor fade time and day and night setpoints
   k. Read the current light level, in footcandles, from interior and exterior photosensors and photocells
   l. Set daylight sensor operating mode
   m. Read/write wall switch lock status
   n. Read watts per square foot for the entire controlled room
   o. Write maximum light level per load for demand response mode
   p. Read/write activation of demand response mode for the room
   q. Activate/restore demand response mode for the room

B. WattStopper product numbers: LMBC-300

2.13 SEGMENT MANAGER

A. For networked applications, the Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default is 80) or 256 bit AES encrypted SSL TCP/IP traffic via a configurable port (default is 443).

B. Each segment manager shall have integral support for at least three segment networks. Segment networks may alternately be connected to the segment manager via external routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment network. Provide the quantity of routers and switches as shown on the plans.
C. Operational features of the Segment Manager shall include the following:

1. Connection to PC or LAN via standard Ethernet TCP/IP via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.

2. Easy to learn and use graphical user interface, compatible with Internet Explorer 8, or equal browser. Shall not require installation of any lighting control software to an end-user PC.

3. Log in security capable of restricting some users to view-only or other limited operations.

4. Automatic discovery of DLM devices and relay panels on the segment network(s). Commissioning beyond activation of the discovery function shall not be required to provide communication, monitoring or control of all local networks and lighting control panels.

5. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.

6. Ability to view and modify room device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On.

7. Ability to set up schedules for rooms and panels, view and override current status of panel channels and relays, and assign relays to groups. Schedules shall automatically set controlled zones or areas to either a normal hours or after hours mode of operation. Support for a minimum of 100 unique schedules, each with up to four time events per day. Support for annual schedules, holiday schedules and unique date-bound schedules.

8. Ability to group rooms and loads for common control by schedules, switches or network commands.

9. Ability to monitor connected load current and display power consumption for areas equipped with room controllers incorporating the integral current monitoring feature.

10. Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control.

11. The Segment Manager shall allow access and control of the overall system database via Native Niagara AX FOX connectivity. Systems that must utilize a Tridium Niagara controller in addition to the programming, scheduling and configuration server are not acceptable.

D. Segment Manager shall support multiple DLM rooms as follows:
1. Support up to 120 network bridges and 900 digital in-room devices (LMSM-3E).

2. Support up to 300 network bridges and 2,200 digital in-room devices, connected via network routers and switches (LMSM-6E).


2.14 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

A. PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.

1. Additional parameters exposed through this method include but are not limited to:
   a. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
   b. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
   c. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
   d. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
   e. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
   f. Load control polarity reversal so that on events turn loads off and vice versa.
   g. Per-load DR (demand response) shed level in units of percent.
   h. Load output pulse mode in increments of 1 second.
   i. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.

2. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
   a. Device list report: All devices in a project listed by type.
   b. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
c. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.

d. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.

e. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.

f. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100%, 2 = all loads 75%, 3 = all loads 50%, 4 = all loads 25%, 5-16 = same as scene 1).

g. Occupancy sensor report: Basic settings including time delay and sensitivity(ies) for all occupancy sensors.

3. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:

a. Set, copy/paste an entire project site of sensor time delays.

b. Set, copy/paste an entire project site of sensor sensitivity settings.

c. Search based on room name and text labels.

d. Filter by product type (i.e. LMRC-212) to allow parameter set by product.

e. Filter by parameter value to search for product with specific configurations.

4. Network-wide firmware upgrading remotely via the BACnet/IP network.


b. Mass firmware update of specifically selected rooms or areas.

c. Mass firmware upgrade of specific products.

B. WattStopper Product Number: LMCS-100, LMCI-100

2.15 LMCP LIGHTING CONTROL PANELS

A. Provide lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:

1. Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 - 8 relays, 1 - 24 relays and 6 four-pole contactors, or 1 - 48 relays and 6 four-pole contactors.

2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. The panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.

3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the
assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:

a. Removable, plug-in terminal blocks with connections for all low voltage terminations.

b. Individual terminal block, override pushbutton, and LED status light for each relay.

c. Direct wired switch inputs associated with each relay shall support 2-wire momentary switches only.

d. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches; digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs; digital IO modules capable of receiving momentary or maintained contact closure inputs or analog sensor inputs; digital daylighting sensors; and digital occupancy sensors. Inputs are divided into two separate digital networks, each capable of supplying 250mA to connected devices.

e. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.

f. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.

g. Group and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any set of relays can be associated with a group for direct on/off control or pattern (scene) control via a simple programming sequence using the relay override pushbuttons and LED displays for groups 1-8 or a handheld IR programmer for groups 1-99.

h. Relay group status for shall be provided through LED indicators for groups 1-8 and via BACnet for groups 1-99. A solid LED indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.

i. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:

   a) Electrical:

      i. 30 amp ballast at 277V

      ii. 20 amp ballast at 347V

      iii. 20 amp tungsten at 120V

      iv. 30 amp resistive at 347V

      v. 1.5 HP motor at 120V

      vi. 14,000 amp short circuit current rating (SCCR) at 347V

      vii. Relays shall be specifically UL 20 listed for control of plug-loads
b) Mechanical:

viii Replaceable, ½” KO mounting with removable Class 2 wire harness.

ix Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel.

x Dual line and load terminals each support two #14 - #12 solid or stranded conductors.

xi Tested to 300,000 mechanical on/off cycles.

4. Isolated low voltage contacts provide for true relay status feedback and pilot light indication.

5. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.

6. Where indicated, lighting control panels designated for control of emergency lighting shall be provided with factory installed provision for automatic by pass of relays controlling emergency circuits upon loss of normal power. Panels shall be properly listed and labeled for use on emergency lighting circuits and shall meet the requirements of UL924 and NFPA 70 - Article 700.

7. Integral system clock shall provide scheduling capabilities for panel-only projects without DLM segment networks or BAS control.

   a. Each panel shall include digital clock capability able to issue system wide automation commands to up to (11) eleven other panels for a total of (12) twelve networked lighting control panels. The clock shall provide capability for up to 254 independent schedule events per panel for each of the ninety-nine system wide channel groups.

   b. The clock capability of each panel shall support the time-based energy saving requirements of applicable local energy codes.

   c. The clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery back up for the clock function and program retention in non-volatile FLASH memory. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.

   d. The clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:

      i  Scheduled ON / OFF 
      ii Manual ON / Scheduled OFF 
      iii Astro ON / OFF (or Photo ON / OFF) 
      iv Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF) 

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e. The user interface shall be a portable IR handheld remote control capable of programming any panel in the system (LMCT-100)

f. The clock capability of each panel shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years.

g. Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable.

8. The lighting control panel can operate as a stand-alone system, or can support schedule, group, and photocell control functions, as configured in a Segment Manager controller, via a segment network connection.

9. The lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 MS/TP-based using the BACnet® protocol.

a. The panel shall have provision for an individual BACnet device ID and shall support the full $2^{22}$ range (0 – 4,193,304). The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.

b. The panel shall support MS/TP MAC addresses in the range of 0 – 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.

c. Lighting control relays shall be controllable as binary output objects in the instance range of 1 – 64. The state of each relay shall be readable and writable by the BAS via the object present value property.

d. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 – 64.

e. The 99 group Normal Hours/After Hours control objects associated with the panel shall be represented by binary value objects in the instance range of 201 – 299. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the normal hours mode. Commanding 0 or NULL shall put the relays into the after hours mode.

f. Setup and commissioning of the panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. Provide BACnet objects for panel setup and control as follows:

i. Binary output objects in the instance range of 1 – 64 (one per relay) for on/off control of relays.

ii. Binary value objects in the instance range of 1 – 99 (one per channel) for normal hours/after hours schedule control.

iii. Binary input objects in the instance range of 1 – 64 (one per relay) for reading true on/off state of the relays.

iv. Analog value objects in the instance range of 101 – 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and
set a 5-minute grace-time period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.

g. The description property for all objects shall be writable via the network and shall be saved in non-volatile memory within the panel.

h. The BO and BV 1 – 99 objects shall support BACnet priority array with a relinquish default of off and after hours respectively. Prioritized writes to the channel BV objects shall propagate prioritized control to each member relay in a way analogous to the BACnet Channel object described in addendum aa. (http://www.bacnet.org/Addenda/Add-135-2010aa.pdf)

i. Panel-aggregate control of relay Force Off at priority 2 shall be available via a single BV5 object. Force On at priority 1 shall be available via a single BV4 object.

j. Lockout of all digital switch buttons connected to a given panel shall be commandable via a single BV2 object. The lock status of any connected switch station shall be represented as BV101-196.

10. WattStopper Product Number: LMCP8, LMCP24 or LMCP48

B. USER INTERFACE
Each lighting control panel system shall be supplied with at least (1) handheld configuration tool (LMCT-100). As a remote programming interface the configuration tool shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following panel-specific functions as a minimum:

1. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.

2. Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.

3. Program up to 254 separate scheduled events. Events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.

4. Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.

5. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.

6. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.

7. An additional handheld IR remote may optionally be specified to be permanently mounted to the panel interior via a retractable anti-theft lanyard to allow for convenient programming of the panel while assuring that the handheld programmer is always present at that panel. An unlimited number of handheld IR remotes may also be purchased for facilities staff as determined by the end user's representative.
8. WattStopper Product Number: LMCT-100

2.16 EMERGENCY LIGHTING CONTROL DEVICES

A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:

1. 120/277 volts, 50/60 Hz, 20 amp ballast rating

2. Push to test button

3. Auxiliary contact for remote test or fire alarm system interface

B. WattStopper Product Numbers: ELCU-100, ELCU-200.

PART 3 – EXECUTION

3.1 PRE-INSTALLATION MEETING

A. A factory authorized manufacturer’s representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:

1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.

2. Review the specifications for low voltage control wiring and termination.

3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.

4. Discuss requirements for integration with other trades.

3.2 CONTRACTOR INSTALLATION AND SERVICES

A. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.

B. Contractor to install all room/area devices using manufacturer’s factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufacturer with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer’s specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.
C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.

D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
   1. Adjust time delay so that controlled area remains lighted while occupied.

E. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
   1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
   2. Sequence of operation, (e.g. manual ON, Auto OFF, etc.)
   3. Load Parameters (e.g. blink warning, etc.)

F. Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner’s requirements. Provide a detailed report to the Architect / Owner of post start-up activity.

3.3 FACTORY SERVICES

A. Upon completion of the installation, the manufacturer’s factory authorized representative shall start up and verify a complete fully functional system.

B. The electrical contractor shall provide both the manufacturer and the electrical engineer with three weeks written notice of the system start up and adjustment date.

C. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

3.4 COMMISSIONING SUPPORT SERVICES

A. On this project, a commissioning agent will be hired to verify the installation and programming of all building systems, which includes the lighting control system. Manufacturer should include an extra day of technician's time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available. Manufacturer is NOT responsible for helping the commissioning agent inspect the individual devices. It will be the commissioning agent's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the agent with this task.

B. The commissioning agent shall work with the electrical contractor during installation of the lighting control hardware to become familiar with the specific products. The agent may also accompany the manufacturer's technicians during their start-up work to better understand the process of testing, calibration and configuration of the products. However, the contractor and manufacturer shall ensure that interfacing with the agent does not prevent them from completing the requirements outlined in the contract documents.
SECTION 270000
BASIC COMMUNICATIONS REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes general administrative and procedural requirements for Division 27, and is intended to supplement, not supersede, the general requirements specified in Division 00.

B. The requirements described herein include the following:
   1. References
   2. Definitions
   3. System Description and Project Conditions
   4. Submittals
   5. Quality Assurance
   6. Delivery, Storage, and Handling
   7. Scheduling
   8. Warranty
   9. Permits and Inspections
   10. Field Quality Control
   11. Project Closeout and Record Documents

C. Related Items
   1. General and Supplementary Conditions: General provisions of the Prime Contract and Divisions 00 and 01 apply to Division 27.
   2. Consult other Divisions and Sections, determine the extent and character of related work, and coordinate Work of Division 27 with that specified elsewhere to produce a complete and operable installation.
   3. Section 270528, “Communications Building Pathways”
   4. Section 270811, “Communications Twisted Pair Testing”
   5. Section 271100, “Communications Equipment Rooms”
   6. Section 271513, “Communications Horizontal Twisted Pair Cabling”
   7. Section 275313, “Communications Clock System”

1.2 REFERENCES

A. General
   1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this specification as though fully repeated herein.
   2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
   3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.

B. Codes: Perform work and furnish materials and equipment under Division 27 in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
1. California Code of Regulations (CCR):
   a. Title 8, “Industrial Relations”
      1) Chapter 3.22, “California Occupational Safety and Health Regulations (CAL/OSHA)"
   b. Title 24, “California Building Standards Code”
      2) Part 2, “California Building Code” (CBC)
      3) Part 3, “California Electrical Code” (CEC)
      4) Part 11, “California Green Building Standards Code” (CALGreen)"

2. National Fire Protection Agency (NFPA)
   a. NFPA 70, “National Electrical Code” (NEC)
   b. NFPA 75, “Protection of Information Technology Equipment”

   b. Part 68, “Connection of Terminal Equipment to the Telephone Network”

4. Other applicable national, state, and local binding building and fire codes

C. Standards: Perform work and furnish materials and equipment under Division 27 in accordance with the latest editions of the following standards as applicable:
   1. Contra Costa Community College District – Districtwide Technology Infrastructure Standard, Revision 02.40 (March 2016)
   2. Building Industry Consulting Services International (BICSI):
      a. Telecommunications Distribution Methods Manual (TDMM)
      c. Wireless Design Reference Manual (WDRM)
   3. EIA testing standards
   4. National Electrical Contractors Association (NECA):
   5. Telecommunications Industry Association (TIA):
      a. ANSI/TIA-568-C.0, “Generic Telecommunications Cabling for Customer Premises”
      b. ANSI/TIA-568-C.1, “Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements”
      c. ANSI/TIA-568-C.2, “Balanced Twisted Pair Telecommunications Cabling and Components”
      e. ANSI/TIA-569-B, “Commercial Building Standard for Telecommunications Pathways and Spaces”
      f. ANSI/TIA/EIA-598-B, “Optical Fiber Cable Color Coding”
      g. ANSI/TIA-606-B, “Administration Standard for Telecommunications Infrastructure”
      h. ANSI-TIA-607-B, “Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises”
      i. ANSI/TIA-758-A, “Customer-Owned Outside Plant Telecommunications Infrastructure Standard”

1.3 DEFINITIONS

A. The definitions of Divisions 00 and 01 shall apply to Division 27 sections.

B. In addition to those definitions of Divisions 00 and 01, the following list of terms as used in this specification defined as follows:
   1. “AFF”: Above Finished Floor
2. "As directed": As directed or instructed by the Owner, or their authorized representative
3. "AHJ": Authority Having Jurisdiction
4. "Cabling": installed media ready for electronic or optical signal circuit use; a complete media connection comprised of cables, termination apparatus (patch panels, blocks, connectors), outlets, connecting media (path cord, crossconnects), labeling
5. "CBC": California Building Code (CCR Title 24 Part 2)
6. "CCR": California Code of Regulations
7. "CEC": California Electrical Code (CCR Title 24 Part 3)
8. "Connect": To install patch cords, equipment cords, crossconnect wire, etc. to complete an electronic or optical signal circuit
9. "Cord": a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper" and "Lead"
10. "Engineer": TEECOM
11. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories
12. "General Contractor": successful bidder
13. "Identifier": A unique code assigned to an element of the Telecommunications infrastructure that links it to its corresponding record
14. "Install": To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Make installation complete and ready for regular operation
15. "IOR": Inspector Of Record
16. "ISP": Inside Plant
17. "LED": Light Emitting Diode
18. "MSDS": Material Safety Data Sheets
19. "NEC": National Electrical Code (NFPA 70)
20. "NEMA": National Electrical Manufacturers Association
22. "NIC": Not In Contract (work or equipment)
23. "OFCl": Owner-furnished contractor-installed; coordinate the integration of components furnished by the Owner; provide mounting hardware, cable, connectors, etc. to ensure proper integration of OFCl equipment
24. "OFE": Owner Furnished Equipment
25. "OSP": Outside Plant
26. "Owner": Contra Costa Community College District
27. "PDF": Portable document format (electronic file format / *.pdf)
28. "Pigtails": a length of cordage having connectors at one end
29. "Provide": To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation
30. "UL": Underwriters Laboratories

1.4 SYSTEM DESCRIPTION AND PROJECT CONDITIONS

A. In circumstances where the Specifications and Drawings conflict, the Drawings shall govern quantity and the Specifications shall govern quality.

1.5 SUBMITTALS

A. Submit required submittals to the Architect in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.

B. Failure to comply with requirements in part or whole shall constitute grounds for rejection.
C. Resubmittals: For resubmittals, provide a cover letter with the resubmittal that lists the action taken and revisions made to each product in response to the Engineer’s submittal review comments. Lack of this actions-taken cover letter shall constitute grounds for non-review and/or rejection of resubmittal packages.

D. Submittal Description: Product Data
1. Obtain written approval from the Engineer for the product data submittal prior to materials and equipment purchase order and prior to installation.
2. Quantity and Media: Submit product data as described in Division 01. In the absence of requirements given, submit product data submittal as directed in writing either as an electronic submittal (preferred) via approved means (e.g., email, e-transmit) or as four printed submittals (not preferred).
3. Format and Organization – Electronic Submittal:
   a. File format shall be PDF, either as a single compiled PDF file or as a PDF portfolio.
   b. PDF files should be produced from original electronic media, not scans of printed media. If scans from prints are the only option, annotate electronically, not on the prints prior to scanning.
   c. Pages should be letter size (8.5" x 11")
   d. Organize the Content in the following order:
      1) Cover
      2) Table of Contents (TOC)
      3) Statement of compliance
      4) Product information
      5) Seismic calculations (as required)
   e. Clearly and precisely indicate the submitted product and accessories by part number using an electronic annotation (arrow, rectangle, oval, etc.). Where the product data presents “part number builds”, list the exact part number of the submitted products and accessories.
   f. Add page numbers in numerical order with no gaps to each page that correctly correspond to the TOC.
4. Format and Organization – Printed Submittal:
   a. Paper shall be letter size (8.5" x 11").
   b. Package printed submittal using a 3-ring binder, clear-front report cover, or similar.
      1) For 3-ring binders, clearly label the cover and spine of each binder with the required “Cover” information (e.g., insert the cover in the front and spine transparent pockets):
   c. Organize the content in the following order:
      1) Cover
      2) Table of Contents (TOC)
      3) Statement of compliance
      4) Product information
      5) Seismic calculations (as required)
   d. Include tabbed separators for improved navigation through the submittal.
   e. Clearly, precisely, and permanently indicate the submitted product and accessories by part number using an arrow stamp or other permanent indicator. Where the product data presents “part number builds”, indicate the exact part number of the submitted products and accessories.
5. Content:
   a. Cover: Include a cover that clearly displays the following information:
      1) Owner name
      2) Project name and address
      3) Submittal name (e.g., “Product Data Submittal for Telecommunications Equipment Rooms”)
      4) Project submittal number
5) Contractor's submittal number (discretionary)
6) Submittal date; format: Month Day, Year (e.g., "January 1, 2013")
7) Specification section numbers included in the submittal (e.g., "Section 271100")
8) Contractor name and contact information

b. Table of Contents (TOC): Include a TOC that lists materials by section number, article and paragraph number. Add a brief product description (what it is, size or color or other optional features), manufacturer and part number. List the submittal page number per product. Example heading for TOC:

<table>
<thead>
<tr>
<th>Section</th>
<th>Article</th>
<th>Paragraph</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Part #</th>
<th>Page #</th>
</tr>
</thead>
</table>

c. Statement of Compliance: Include a "Statement of Compliance" letter or memorandum on the submitter's company letterhead from the highest ranking employee assigned to this project stating the submittal has been reviewed (quality control check) and is in full compliance with the requirements of the contract documents, and listing the submittal's contents. Wet sign (and stamped, if applicable) the letter.

d. Product Information: Include manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary) that clearly describe the product's characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color and finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Include products listed in the specifications, at a minimum. Include relevant products that will be installed, which are not listed in the specifications.

e. Seismic Calculations: Include structural calculations for anchorage and seismic restraint of floor-mounted equipment (such as racks, frames, cabinets), wall-mounted equipment (such as video display equipment, etc.), and overhead-mounted equipment (such as cable tray, overhead cable support, etc.) in conformance with CBC, Section 1601A. Calculations shall be based on fully loaded equipment and support systems. Calculations shall demonstrate that the equipment and support systems will remain attached to the mounting surface during and after experiencing seismic forces in conformance with the CBC. A Structural Engineer registered in the State of California shall prepare Structural Calculations, and shall wet stamp and sign them. Obtain approval from DSA for the calculations.

E. Submittal Description: Shop Drawings

1. Prior to the start of work, submit shop drawings and obtain written approval from the Owner for the shop drawings submittal.
2. Quantity and Media: Submit shop drawings as described in Division 01. In the absence of requirements given, submit shop drawings as directed in writing either an electronic submittal (preferred) via approved means (email, e-transmit, FTP upload) or four printed and bound sets on bond.
3. Format:
   a. Use the same sheet size as the contract drawings.
   b. Use the same title block as the contract drawings, modified to include contractor information.
   c. Text: 3/32" - 1/8" high when plotted at full size.
   d. Use identical symbols as those in the contract drawings.
   e. Screen background information.
   f. Plot system components (symbols, outlet, devices, pathways, cable routes, etc.) and text using a heavier line weight sufficient enough to stand out against background information.
   g. Scaling:
      1) Scale floor plans and reflected ceiling plans at 1/8"=1'-0"
      2) Scale enlarged room plans at 1/4"=1'-0"
4. Content:
   a. Cover Letter: Accompany each shop drawing submittal with a cover letter stating that the shop drawings have been thoroughly reviewed by the Contractor and are in full compliance with the requirements of the contract documents. Have the person who prepared the submittal sign (and stamped, if applicable) the cover letter and include a drawing index. Failure to comply with this requirement shall constitute grounds for rejection of submittal.
   b. Drawings: Shop drawing submittals shall consist of symbols list, point-to-point diagrams, block diagrams, riser diagrams, line diagrams, floor plans, reflected ceiling plans, enlarged room plans, wall and rack elevations, installation details, and other aspects of the system. Include detailed labeling examples for cables, outlets, termination apparatus, devices, equipment, etc.
   c. Seismic Calculations: Include structural calculations for anchorage and seismic restraint of floor-mounted equipment (such as racks, frames, cabinets), wall-mounted equipment (such as video display equipment, etc.); and overhead-mounted equipment (such as cable tray, overhead cable support, etc.) in conformance with CBC, Section 1601A. Calculations shall be based on fully loaded equipment and support systems. Calculations shall demonstrate that the equipment and support systems will remain attached to the mounting surface during and after experiencing seismic forces in conformance with the CBC. A Structural Engineer registered in the State of California shall prepare Structural Calculations, and shall wet stamp and sign them. Obtain approval from DSA for the calculations.

F. Submittal Description: As-Built Drawings
1. Quantity and Media: Submit as-built drawings as described in Division 01. In the absence of requirements given, submit as-built drawings as directed in writing as electronic files via approved media (or four printed and bound sets on bond, if approved).
2. Format:
   a. Use the same sheet size as the contract drawings.
   b. Use the same title block as the contract drawings, modified to include contractor information.
   c. Text: 3/32" - 1/8" high when plotted at full size.
   d. Use symbols identical to the symbols shown on the contract drawings.
   e. Screen background information.
   f. Plot system components (symbols, outlet, devices, pathways, cable routes, etc.) and text using a heavier line weight sufficient enough to stand out against background information.
   g. Electronic files shall be native format and plotted PDF files. The file names shall include the sheet number.
3. Content:
   a. Submit as-built drawings that fully represent actual installed conditions and that incorporate modifications made during the course of construction.
   b. Symbols List
   c. Diagrams, such as (but not limited to) point-to-point diagrams, block diagrams, riser diagrams, line diagrams, and other diagrams that conceptually describe the system
   d. Floor Plans and Reflected Ceiling Plans: Scale plans at 1/8"=1'-0". Plans shall show:
      1) Locations and identifiers of telecommunications outlets
      2) Routes, types, sizes, and quantities of pathways (such as cable trays, conduits, hangers, and other pathways)
   e. Enlarged Rooms Layouts: Applicable rooms: MTR, TRs, MDF, BDFs, IDF. Room drawings shall show:
1) Floor layouts – scaled at either 1/4"=1'-0", showing dimensioned placement of equipment cabinets/frames, rack bays, etc.
2) Overhead layouts – scaled at either 1/4"=1'-0", showing dimensioned placement of overhead cable support (e.g., cable tray, cable runway, conduit sleeves, etc.)
3) Rack elevations – scaled at 1"=1'-0", showing placement of termination apparatus and other equipment installed onto rack bays
4) Wall Elevations – scaled at 1"=1'-0", showing dimensioned placement of termination apparatus (e.g., termination/crossconnect blocks)

G. Submittal Description: Operation and Maintenance (O&M) Manual
1. Quantity and Media: Submit O&M Manual as described in Division 01. In the absence of requirements given, submit one packaged O&M Manual set.
2. Format and Organization:
   a. Include contents in a 3-ring binder with front cover and spine clear pockets for insertion of the cover information.
   b. Cover shall include the following information:
      1) Owner name
      2) Project name and address
      3) Manual name (e.g., "Operation and Maintenance Manual for Telecommunications Cabling System")
      4) Date; format: Month Day, Year (e.g., "January 1, 2014")
      5) Contractor name and contact information
   c. Include a ToC at the beginning that lists the contents.
   d. Include tabbed separators for improved navigation through the manual.
3. Content:
   a. Instructions on making a warranty claim during the warranty period
   b. Contact information during the warranty period
   c. Contact information beyond the warranty period for maintenance and related service
   d. As-built drawings, as described above, printed on tabloid size (17"x11") paper and as electronic files – both native files and plotted PDF files
   e. Product catalog/technical information sheets for each component provided under applicable section (typically, this is the [or similar to] the accepted product data submittal), printed on letter size (8.5" x 11") paper and as electronic files in PDF format
   f. Warranty certificate from the manufacturer and the contractor, printed on letter size (8.5" x 11") paper, wet signed as applicable
   g. Manufacturer’s instructions for system or component use
   h. Instructions and requirements for proper maintenance (according to the manufacturer) and as to maintain warranty

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications
1. Five continuous years, minimum, design and manufacture of the materials and equipment specified herein.
2. Manufacturer(s) of products and equipment specified herein shall demonstrate that they have a quality assurance program in place to assure that the specifications are met. Include in the program, at a minimum, provisions for:
   a. Incoming inspection of raw materials
   b. In-process inspection and final inspection of the cable product
   c. Calibration procedures of test equipment to be used in the qualifications of the product
   d. Recall procedures in the event that out of calibration equipment is identified.
3. Conform to government standards on quality assurance for applications within these specifications.
B. Contractor Qualifications:
1. A current, active, and valid and C7 or C10 California State Contractors License
2. Manufacturer certification for the specified cabling system, including the ability to provide a
   25-year extended warranty for the structured cabling system.
3. Five, minimum, continuous years of experience
4. Five, minimum, completed projects similar to scope and cost
5. Evidence of technicians qualified for the work
6. IBEW / CWA union affiliation

C. Materials
1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused,
   without defects and of current manufacturer, materials
2. Use specified products and applications, unless otherwise submitted and approved in
   writing.

D. Regulatory Requirements
1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters
   wherever such standards have been established and shall conform to the regulations of the
   State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under
   Division 27 shall confirm to the most stringent of the applicable codes.
2. Provide the quality identified within these specifications and drawings when codes,
   standards, regulations, etc. allow Work of lesser quality or extent. The contract documents
   address the minimum requirements for construction.

E. Drawings
1. Follow the general layout shown on the drawings except where other work may conflict with
   the drawings.
2. Drawings for the work within this division are essentially diagrammatic within the constraints
   of the symbology applied.
3. The drawings do not fully represent the entire installation. Drawings indicate the general
   route for pathways and cables, and show general locations of outlets. The drawings might
   not expressly show every conduit, sleeve, hanger, etc., but a complete system is required.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery
1. Do not deliver products to the site until protected storage space is available.
2. Coordinate materials delivery with installation schedule to minimize storage time at jobsite.
3. Deliver materials in manufacturer's original, unopened, undamaged packaging and
   containers with identification labels (name of the manufacturer, product name and number,
   type, grade, UL classification, etc.) intact.
4. Immediately replace equipment damaged during shipping at no cost to the Owner, so as not
   to impact the construction schedule.

B. Storage and Protection
1. Store materials in clean, dry, ventilated space free from temperature and humidity conditions
   (as recommended by manufacturer) and protected from exposure to harmful weather
   conditions.
2. Comply with manufacturer's storage requirements for each product. Comply with
   recommended procedures, precautions or remedies as described in the MSDS as
   applicable.
3. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt,
   water, construction debris, and traffic.
4. Storage outdoors covered by rainproof material is not acceptable.
5. Provide heat where required to prevent condensation or temperature related damage.

C. Handling
   1. Handle materials and equipment in accordance with manufacturer’s written instructions.
      Handle with care to prevent damage, breakage, denting, and scoring.
   2. Do not install damaged materials and equipment. Replace damaged equipment at no cost to the Owner.

1.8 SCHEDULING

A. Unless otherwise specified, the construction schedules of the Sections within Division 27 may be combined into a single, overall schedule.

B. Do not proceed without written approval from the Owner or Owner’s Representative for schedule of this Work.

1.9 PROJECT MANAGEMENT AND COORDINATION

A. Concurrent Installation
   1. The network may be installed concurrent with the work of Division 27. Coordinate your work with the Owner’s/network integrator’s work. For example, coordinate scope and dates for rack and cabling (terminations) readiness to allow the network integrator to plan and schedule installation of the network equipment (for example, access switches).

B. Role of the Engineer
   1. The Owner has retained the Engineer’s services through construction. During construction, the Engineer will work with and assist the Contractor as follows (in general):
      a. Review product data and shop drawings submittals for general compliance with the contract drawings and specifications.
      b. Provide interpretation and clarification of project contract documents
      c. Reply to (and ‘process’) relevant Requests for Information (RFIs)
      d. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.
      e. Interpret field problems for Owner, and translate between Owner and Construction Team.
      f. Review the testing procedures to confirm compliance with industry-accepted practices.
      g. Observe the work for general compliance with the contract documents and to ensure that the installation meets the design intent of the system, and report progress to the Owner.

C. Use of Electronic Drawing Files
   1. Should the Contractor require the Engineer’s electronic files to produce shop drawings and/or as-built drawings, the Engineer will require the Contractor sign a file release agreement.
1.10 WARRANTY

A. As a minimum, warrant products and labor provided will, under normal use and service, be free from defects and faulty workmanship for period of 1 year from the date of acceptance. During the warranty period the entire system shall be kept in operating condition at no additional material or labor costs to the Owner. Also refer to specific sections for additional warranty requirements that supersede the project’s minimum warranty.

B. Render service within 24 hours of system failure notification. Note deviations or improvements to this service at the time of bid and obtain written acceptance from the Owner, or Owner’s Representative.

C. Manufacturers of the major system components shall maintain a replacement parts department and provide testing equipment when needed. Provide complete replacement parts within 24 hours during the warranty period.

D. Conformance to certain government standards on quality assurance may be required for some applications outlined in these specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials used shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards, other applicable federal, state, and local laws.

B. Product numbers are subject to change by the manufacturer without notification. In the event a product number is invalid or conflicts with the written description, notify the Engineer in writing prior to ordering the material and performing installation work.

2.2 SUBSTITUTIONS

A. Conform to the substitutions requirements and procedures outlined in Division 01.

B. Substitutions will only be allowed for products not required to match existing products.

C. Only one substitution for each product specified will be considered.

D. Where products are noted as "or equal", a product of equivalent design, manufacture, and performance will be considered. Submit product data (product information, catalog cuts, pertinent test data, etc.) to substantiate that the product is in fact equivalent to that specified. The burden of proof that the substituted product is equivalent to the specified product rests with the Contractor. Whenever material, process or equipment is specified in accordance with an industry specification (ANSI, TIA, etc), UL rating, or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit supporting test data to substantiate compliance.
E. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the contract documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when "or equal" follows the manufacturers' names or model number(s).

F. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.

G. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from provisions of the specifications.

H. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work.

PART 3 - EXECUTION

3.1 PERMITS AND INSPECTIONS

A. Obtain and pay for permits and inspections required for the work.

B. Furnish materials and execute workmanship for this work in conformance with applicable legal and code requirements.

C. Perform tests required herein, or as may be reasonably required to demonstrate conformance with the Specifications or with the requirements of legal authority having jurisdiction.

D. Arrange and pay for review/inspection from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with requirements of reference codes indicated herein.

3.2 EXAMINATION

A. Verify existing conditions, stated under other sections, are acceptable for installation in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

A. Staffing: Provide a qualified foreman to supervise the crew performing the work and who is present at the job site at times work is being performed.

B. Construction Meetings: Participate in construction coordination meetings throughout the course of construction to review the progress and to resolve issues and conflicts. Prepare and distribute meeting agenda for telecommunication issues prior to, and meeting notes after meetings, in a format acceptable to the Owner. Publish meeting notes within 3 business days following the meeting.
C. Scheduling: Perform the work within the approved construction schedule. Keep the construction schedule current, based on the results of the construction meetings. At a minimum, schedule shall document critical due dates, tasks, and milestones. Submit revised schedules for approval within 3 business days whenever there are modifications.

D. Inspection: Inspect the work after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion ready for inspection. Document completion and inspection as required.

3.4 INSTALLATION

A. Complete work in a neat, high-quality manner, relative to common industry practices, and in accordance to NECA “Standard of Installation”.

B. Complete work in conformance to applicable federal, state and local codes, and telephone standards.

C. Coordinate the entire installation throughout the construction team (general contractor and subcontractors).

D. Manufacturer's Instructions: Comply with manufacturer's published installation instructions, product data, product technical bulletins, product catalog, and other instructions for installation. Maintain a file on the jobsite of MSDSs for each product delivered to jobsite packaged with an MSDS.

E. Adjusting: Make changes and revisions to systems to optimize operation for final use. Make changes to systems such that defects in workmanship are corrected and completed systems pass the minimum test requirements.

F. Protection: Protect installed products and finish surfaces from damage during construction.

G. Repair/Restoration: Replace or repair work completed by others that you deface or destroy. Pay the full cost of this repair/replacement. Repair defects prior to system acceptance.

3.5 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove unused, excess, and left over products, debris, spills, or other excess materials. Remove installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.

C. Repair or replace damaged installed products.

D. Legally dispose of debris.

E. Clean installed products in accordance with manufacturer's instructions prior to Owner's, or Owner's Representative's, punch walk.
3.6 PUNCH WALKS AND PUNCH LISTS

A. Punching the Work of individual Sections of Division 27 may be combined when noted so.

B. Execute a punch walk with the Engineer and the Owner to observe Work.

C. Develop a punch list for items needing correction. Issue this punch list to Engineer.

D. Correct the Work as noted on punch list.

E. Execute follow up punch walk with the Engineer and the Owner to verify punch list items have been corrected.

3.7 SYSTEM ACCEPTANCE

A. Complete corrections (punch list items) prior to submitting acceptance certificate.

B. On completion of the acceptance test, submit system acceptance certificate to the Owner requesting their signature and return of the certificate. Issue copies of the signed certificate back to the Owner with copy to the Engineer.

END OF SECTION
SECTION 270528

COMMUNICATIONS BUILDING PATHWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Pathway systems within buildings to support low voltage systems - namely conduit, surface mounted raceway, and rated sleeves.

B. Related Sections
   1. Comply with the Related Sections paragraph of Section 270000.
   2. Section 271100, "Communication Rooms"

1.2 REFERENCES

A. Comply with the References requirements of Section 270000.

B. In additional to those codes, standards, etc., listed in 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
   1. American National Standards Institute (ANSI)
      a. ANSI C80.3, "Specifications for Electrical Metallic Tubing"
   2. ASTM International
      b. ASTM A653, "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process"
      c. ASTM D1654, "Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments"
   3. International Electronic Committee (IEC)
      a. ANSI/IEC 60529, "Degrees of Protection Provided by Enclosures (IP Code)"
   4. National Electrical Manufacturer Association (NEMA)
      a. NEMA 250, "Enclosures for Electrical Equipment (1000 volts maximum)"
      b. NEMA FB 1, "Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable"
      c. NEMA OS 1, "Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports"
      d. NEMA OS 2, "Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports"
      e. NEMA OS 3, "Selection and Installation Guidelines for Electrical Outlet Boxes"
   5. Underwriters Laboratories (UL)
      a. UL 50, "Enclosures for Electrical Equipment, Non-Environmental Considerations"
      b. UL 467, "Grounding and Bonding Equipment"
      c. UL 514A, "Metal Outlet Boxes"
      d. UL 514B, "Conduit, Tubing, and Cable Fittings"
      e. UL 514C, "Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers"
      f. UL 797, "Electrical Metallic Tubing - Steel"
   6. Underwriters Laboratories (UL)
      a. UL 467, "Grounding and Bonding Equipment"
1.3 DEFINITIONS

A. Definitions of Section 270000 apply to this Section.

B. In addition to those Definitions of Section 270000, the following list of terms as used in this Section defined as follows:

1. "Backbox": A box [see "Box"] used to house cable terminations, to house devices, and to interface with cords/equipment; a backbox is installed with walls (such as within the cavities of framed walls and/or cast-in-place within concrete walls) such that the outlet/device finish (e.g., the coverplate/faceplate) is flush with the wall finish

2. "Box": A box (often 5-sided with 1 side open) manufactured of sheet metal with welded corners, drawn metal, cast metal, or nonmetallic material (thermoplastic) in accordance with NEMA OS 1 or NEMA OS 2 and installed in accordance with NFPA 70 Article 314; available in different sizes (volumes) and modular design configurations (gangeable) that may be field assembled, one to another, to accommodate multiple devices; boxes may be used as outlet boxes, device boxes, backboxes, junction boxes, or pull boxes, depending on their intended use, and handhole enclosures.

3. "Cable Strap": A flexible cable support that generally 'wraps' around cables and 'latches' into a fixed position, most often textile, available in different sizes (to support different quantities of cables) and with different attachment hardware suitting multiple installation methods (e.g., wire support, beam flange clip, etc.).

4. "CEC": California Electrical Code (California Code of Regulations, Title 24 Part 3)

5. "Device Box": A box [see "Box"] with provisions for attaching and housing electrical devices (switches, receptacles, or similar wiring devices) manufactured in accordance with NEMA OS 1 and NEMA OS 2 and installed in accordance with NFPA 70 Article 314; available in different sizes (volumes) and modular design configurations (gangeable) that may be field assembled, one to another, to accommodate multiple devices

6. "EIMC": Electrical Intermediate Metal Conduit – see "IMC"

7. "EMT": Electrical Metallic Tubing type conduit, as defined in ANSI C80.3 and NFPA 70 Article 358. An unthreaded thinwall raceway, generally made of steel (ferrous) with protective coatings or aluminum (nonferrous), of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed utilizing appropriate fittings (per NEC Article 358) "FMT": Flexible Metal Tubing type conduit, as defined in NFPA 70 Article 360

9. "Enclosure": The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage.

10. "Floor Box": A box [see "Box"] used to house cable terminations, to house wiring devices, and to interface with cords/equipment; a floor box is a special purpose box installed with floors (such as cast-in-place within concrete) such that the box finish (e.g., the coverplate) is flush with the floor finish

11. "HDPE": High Density Polyethylene type conduit, as defined in NFPA 70 Article 353

12. "Innerduct": A continuous cylindrical pipe fabricated of extruded thermoplastic, available in corrugated, smooth, or other wall types and in different sizes (to support different quantities of cables), generally to provide a separate pulling channel and physical protection for fiber, coaxial, and metallic cables in telecommunications and other networks, and used in multiple applications such as the following:

   a. within conduit to compartmentalize or create 'sub-ducts'

   b. in cable tray to create an isolated pathway

   c. by itself as a pathway system

13. "IMC": Intermediate Metal Conduit type conduit, as defined in ANSI C80.5 and NFPA 70 Article 342
14. "Junction Box": A box used to join different runs of raceway (such as conduit) or cables, or both, and to provide space for the connection and branching of the enclosed conductors; most boxes can be used solely as junction boxes as long as they are used with an appropriate cover and with appropriate (code-required) access

15. "LFMC": Liquidtight Flexible Metal Conduit type conduit, as defined in NFPA 70 Article 353

16. "Outlet Box": A box (see "Box") used to house cable terminations (connectors, modular jacks, receptacles, or similar wiring interfaces) and to interface with cords/equipment

17. "NEC": National Electrical Code (NFPA 70)

18. "NEMA": National Electrical Manufacturers Association

19. "NFPA": National Fire Protection Agency

20. "Pull Box": A box used in a conduit-based pathway system to allow access to and enclose conduit ends for placing cables and to house the interface between duct banks segments

21. "RMC": Rigid Metal Conduit type conduit, as defined in NFPA 70 Article 344 and ANSI C80.1

22. "RNC": Rigid Nonmetallic Conduit type conduit, as defined in NFPA 70 Article 352 and as manufactured to NEMA TC 2 specifications

23. "UL": Underwriters Laboratories

1.4 SYSTEM DESCRIPTION

A. The scope of work of this section includes planning and coordination with General Contractor and other trades of inside plant conduit pathway systems, furnishing necessary materials, and labor and associated services required to install these pathway systems.

B. The drawings do not explicitly show on plans each and every conduit run needed for the project. Apply the guidelines described in this section and on the drawings to support the cabling described in Division 27 and shown on the low voltage drawings, and provide reasonably inferred standard conduits, fittings, and products required to complete the conduit installation to meet the design intent.

C. The scope of work includes conduit, boxes, and related construction materials that may not be expressly specified herein or expressly called out on the drawings, such as: 1- and 2-hole straps, nail straps, clamps and clamp backs, strut clamps, U-bolts, pipe hangers, clip-in and bolted hangers, bushings, ground bushings, service entrance cap/weatherhead, pull rope/tape, etc.

D. The scope of work includes basic construction materials that may not be explicitly specified herein or called out on the drawings, such as: concrete anchors, inserts, and/or expansion bolts; concrete fasteners; powder-actuated pins; construction channel/strut; threaded rod; wood fasteners (lag screws); beam clamps; purlin clips; stud box supports/brackets; floor-mount box supports; T-bar ceiling box support bar; channel-mount box supports; bonding pigtales; drywall ring (for ring & string); etc.

E. Conduit Systems, including Pull Boxes

1. Provide conduit systems in accordance with CEC (Chapter 3 and Article 250), UL listing information, manufacturer's instructions, and compliant to local inspections and seismic restraint requirements. Conduit systems shall conform to ANSI/TIA-568-B standard and BICSI TDMM guidelines. Complete shall include all reasonably inferred conduits, fittings, connectors, couplers, straps, pull boxes, supports, etc., necessary for a complete installation to meet the intended application whether noted, indicated or specified in the Contract Documents or not.

2. Provide pull boxes as necessary to facilitate proper cable placement, including the following:
   a. no more than 180 degrees bend between placement points
b. no more than 150-200 feet conduit length (depending on the total bend between end points)
c. to meet AHJ requirements

3. Seismic Bracing: Provide seismic bracing to conduit system (duct banks, pull boxes, etc). Seismic bracing shall be approved by a structural engineer licensed in the state of California.

4. Seismic Joints: Provide seismic joints to conduit at building seismic joints. Seismic joint configurations shall be approved by a structural engineer licensed in the state of California.

5. Expansion Joints/Fittings: Provide expansion joints and/or fittings to conduit where necessary. Expansion joints/fittings shall be approved by a structural engineer licensed in the state of California.

6. Conduit systems shall be mechanically and electrically continuous throughout. Where EMT and associated fittings are used as part of equipment grounding system, provide a bonding type locknut where hub type fitting terminates into a threadless opening and provide compression ring type fittings for terminating and coupling.

7. Minimum Conduit Size: Refer to drawings. If not noted on the drawings, the minimum conduit size shall be 1".

8. Bend radii for conduit trade sizes 63.5 mm (2-1/2") and larger shall be 10 times the conduit outside diameter (OD) and bend radii for conduit trade sizes 51 mm (2") and smaller shall be 8 times the conduit OD.

9. Provide transition couplings where dissimilar conduit types are joined.

10. Conduit bodies or 'condulets' (LBs, etc.) are prohibited for telecommunications and audiovisual cables.

11. For type EMT conduits:
   a. Provide steel (preferred) zinc plated or die cast set screw (or compression fittings). For set screw fittings, provide single screw fittings (e.g., 1-screw connectors and 2-screw couplers) for 37mm (1.5") and smaller conduits and provide double screw fittings (e.g., 2-screw connectors and 4-screw couplers) for 51mm (2") and larger conduits.
   b. When cast in concrete, embedded masonry, or installed in dry locations (as defined by CEC), provide compression fittings and couplings.
   c. When installed in damp locations (as defined by CEC), provide rain-tight type fittings and couplings.

12. When attaching to concrete ceilings, provide vibration and shock resistant bases.

13. Conduit Straps: Provide steel straps – for interior applications, provide straps without spacers

14. Provide a pull line into each conduit/duct between pull points:
   a. Where boxes are exposed in damp or wet locations or located in hazardous areas, provide cast metal boxes with gasketed cast metal cover plates.
   b. Provide supports for pull (and junction) boxes independently of conduit system and directly to the structure above. Provide seismic bracing for pull boxes.

15. Labeling:
   a. Provide permanent labels on conduit ends and pull box lids.

16. Conduit Application:
   a. At interior concealed or exposed applications, 4" and smaller, provide EMT type conduit, unless otherwise note. EMT is the preferred conduit type.

F. Clearances (minimum):

1. From fluorescent light fixtures, or other EMI sources = 6 inches (150 mm)
2. From any motor, transformer = 48 inches (1,220mm)
3. From flue, hot water, steam line or other non-insulated heat sources = 12 inches (300 mm)
4. No conduit and/or supports shall encroach into ceiling height, head room of walkways, and/or doorways.
G. Penetrations:
   1. When penetrating partitions and other construction assemblies, use approved methods.
   2. When penetrating concrete walls (including shear walls) and/or floors, scan the area to be penetrated and core openings using methods approved by the structural engineer and by the AHJ. Obtain written approval for locations and means when not using methods included in the contract documents.
   3. When penetrating fire rated assemblies, provide UL Classified and FM Approved fire rated systems in accordance with ASTM E814 (UL1479). Provide labels at both sides of the penetration. Refer to drawings for approved systems per application.
   4. When penetrating acoustic rated assemblies, provide sealant to fill gaps, cavities, etc, to fully seal penetration.

H. Outlet Boxes
   1. Provide outlet boxes and covers/rings (raised and/or flat) in accordance with CEC Article 314 and NEMA OS 3. Ground and bond metal outlet boxes in accordance with NEC Article 250, Parts I, IV, V, VI, VII, and X.
   2. Provide support for outlet boxes. Outlet boxes for telecommunications and audiovisual may share a support bracket (such as a stud span bracket) with electrical outlet boxes.

I. Fire Rated Sleeves
   1. Provide complete fire rated sleeve systems where shown on the drawings and where cables penetrate rated walls, in accordance with ASTM E814 (UL1479). Complete shall include sleeves, brackets, frames, plates, etc, and other required accessories necessary for a complete installation according to UL System drawings.
   2. Provide complete fire rated sleeve systems equal to (or greater than) the F rating of the barrier in which the device is installed.
   3. Provide a system label at each penetration instance.

J. Spiral Wrap
   1. Provide spiral wrap to support and dress cables from feed pathways to the point where the cables enter the furniture system.

1.5 SUBMITTALS

A. General: Conform to Submittal requirements as described in Section 270000.

B. Quantity: Furnish quantities of each submittal as noted in Section 270000.

C. Submittal Requirements Prior to the Start of Construction:
   1. Product Data Submittal, showing product dimensions, fabrications materials, fabrication details, knockout sizes and locations, capacities, finishes, and accessories
   2. Shop Drawings Submittal, consisting of proposed changes to pathways (routes, types, sizes, etc.) compared to the contract documents
   3. Seismic Calculations for Anchoring and Bracing: Submit seismic calculations for support systems in conformance Section 270000. Calculations shall be prepared and signed by a Structural Engineer registered in the state of California. If used, specify proof loads for drilled-in anchors.

D. Submittal Requirements at Close Out:
   1. As-Built Drawings, showing the routes/locations, dimensions, types, sizes, quantities, etc., of pathways/pathway devices.
2. O&M Manual, including as-built, a parts list, repair information, and detailing ongoing maintenance requirements

E. Substitutions
   1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.

1.6 QUALITY ASSURANCE
   A. Comply with Quality Assurance requirements of section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING
   A. Comply with Delivery, Storage and Handling requirements of section 270000.

1.8 WARRANTY
   A. Comply with Warranty requirements of section 270000.

PART 2 - PRODUCTS

2.1 ELECTRICAL METALLIC TUBING (TYPE EMT) CONDUIT AND FITTINGS

   A. Application: Products and assembled system shall be suitable for indoor applications, in accordance with the NEC Article 358

   B. Type EMT Conduit:
      1. Type EMT conduit shall be formed of cold rolled strip steel, electrical-resistance welded continuously along the longitudinal seam, and zinc coated after welding. Type EMT conduit bore shall be smooth and free of blisters, nicks or other imperfections which could mar cables.
      2. Type EMT conduit shall be listed by a nationally recognized testing laboratory to UL 797, and shall bear (stamped or molded on conduit and fittings) the UL label. Markings shall be permanent. Type EMT conduit shall meet ANSI C80.3 specifications.
      3. Type EMT conduit shall be recognized as a bonding conductor per NEC Article 250.118
      4. Factory elbows and bends minimum bend radius shall be 48".
      5. Manufacturers – Type EMT Conduit:
         a. Allied Tube and Conduit Co (Electrical Group) "E-Z Pull" EMT conduit
         b. Cal Conduit Products "CalBrite" EMT conduit
         c. Republic Conduit
         d. Western Tube and Conduit Corp
         e. Or equal

   C. Fittings for EMT:
      1. Fittings (connectors, couplers, straps, accessories, etc.) shall be listed by a nationally recognized testing laboratory to UL 514B, and shall bear the UL label (stamped or molded - such markings shall be permanent).
      2. Fittings shall be manufactured compliant to ANSI/NEMA FB 1.
      3. Standard Set-Screw Fittings: fabricated of steel with zinc electro-plated finish. Die cast zinc / cast malleable iron fittings not acceptable. Set-screws shall be case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
4. Compression Fittings: gland and ring compression type construction; fabricated of steel zinc plated or cast malleable iron; UL Listed as raintight and suitable for concrete

5. Manufacturers – Fittings for EMT
   a. Appleton Electric Co and/or O-Z Gedney (Emerson Electric Co)
   b. Thomas & Betts Corp
   c. Or equal

D. Deflection/Expansion Sleeve:
   1. Application: Deflection/expansion sleeve shall compensate for movement in any direction between two conduit ends and shall withstand occasional vibration transmitted to conduit by rotating equipment or vehicular traffic.
   2. Deflection/expansion sleeve shall be listed by a nationally recognized testing laboratory to UL 514B and UL 467, and shall bear the UL label (stamped or molded - such markings shall be permanent).
   3. Deflection/expansion sleeve shall be fabricated of an inner sleeve, bonding braid, a neoprene outer sleeve with internal flexible stainless steel braid and outer stainless steel bands, ended with couplings (for connection to conduits).
   4. Deflection/expansion sleeve shall accommodate 0.75 inch (19mm) deflection, expansion, contraction, or parallel misalignment in any direction, shall allow up to 30 degree angular deflections, and shall be raintight.
   5. Manufacturer – EMT Expansion/Deflection Sleeve:
      a. Cooper Crouse-Hinds XD series
      b. O-Z Gedney (Emerson Electric Co) DX series
      c. Or equal

E. Expansion Sleeve:
   1. Application: Expansion sleeve shall compensate for parallel movement between two conduits.
   2. Expansion sleeve shall comply with UL514.B and NEMA FB-1.
   3. Expansion sleeve shall be fabricated of an inner steel sleeve with an oversized outer sleeve sealed with slip bushings, configured such that the outer sleeve can move over the inner sleeve. Sleeve shall come equipped with internal or external bonding braid and be ended with couplers suitable to connect to conduit ends.
   4. Manufacturers – EMT Expansion Sleeve:
      a. Cooper Crouse-Hinds XJG-EMT series
      b. O-Z Gedney (Emerson Electric Co) TX series
      c. Or equal

2.2 PULL STRING

A. Application: For use with manual or power fishing systems for light duty cable or tape pulling applications

B. Description: round, woven, polypropylene line
   1. Packaged in storage container with easy, quick, and tangle-free dispensing
   2. UV resistant, and resistant to rot and mildew
   3. Low elongation

C. Manufacturers:
   1. Ideal Industries Inc Powr-Fish® or Valu-Line™ poly pull line
   2. Klein Tools #56110 poly pull line
   3. Or equal
2.3 PULL BOXES

A. Application: For use indoors as cable placement point (pull box) for low voltage cabling and wiring within a conduit raceway system.

B. Compliances:
1. Pull boxes shall meet the requirements of UL 50 and NEMA Type 1.
2. Pull boxes shall be listed by a nationally recognized testing laboratory for the purpose.

C. Material and Finish:
1. Thickness: 16 gauge, minimum
2. Material: the following materials are acceptable for pull boxes
   a. Pre-galvanized steel (ASTM A653), then formed
   b. Mild steel formed, then hot-dipped galvanized (per ASTM A123)
   c. Mild steel formed, then painted (polyester or epoxy powder coat, meeting ASTM D1654)

D. Size: pull box size shall comply with CEC 314.28

E. Configuration: pull boxes shall —— Covers shall be secured by machine screws at 6 inches intervals.

F. Manufacturers:
1. Cooper B-Line (Eaton)
2. Hoffman (Pentair)
3. Hubbell Wiegmann (SC Series enclosures, as an example)
4. Or equal

2.4 STEEL OUTLET BOXES AND COVERS

A. Application: For use indoors as outlet box, backbox, and/or junction box of low voltage systems to house wiring, cabling, terminations, and connectors; may also house and support components.
1. Outlet boxes shall permit access to conductors for maintenance
2. Outlet boxes shall come with knock-outs or punch-outs for easy creation of holes to accept conduit connectors.

B. Compliances:
1. Outlet boxes shall meet the requirements of CEC Article 314.
2. Outlet boxes shall be listed by a nationally recognized testing laboratory to UL 514A for Class 2 and Class 3 power-limited circuits (such as data and signal) providing bonding without the use of bonding jumpers, for remote control circuits, and for telecommunications circuits in accordance with NEC Article 314.
3. Outlet boxes shall be manufactured compliant to NEMA: FB-1 and OS-1.
4. Outlet boxes shall be fire resistant and suitable for use in rated spaces (reference: UL Fire Resistance Directory / "Orange Book").

C. Material and Finish:
1. Material: AISI/SAE 1008 Steel
2. Thickness: CEC 314.40(B) / 1.59 mm (0.0625in), minimum
3. Finish: G60 hot dip zinc galvanized (0.60 oz/sq ft), meeting ASTM A123, or pre-galvanized (continuous sheet galvanizing) meeting per ASTM A653
4. Finish Thickness: ~0.0005 inches
D. Square Box and Covers/Rings – 5"
   1. Dimensions: 5 in square x 2.875 in deep
   2. Volume: 64 in³
   3. Outlet box shall come equipped with integrated cable management/slack support.
   4. Manufacturers:
      a. Randl Industries
         1) #T-55017; "5 Square" outlet box, knockouts: one 1" + one 1-1/4" per side, one 1/2" per back
         2) #T-55018; "5 Square" outlet box, knockouts: one 1/2", + one 3/4" + one 1" per side, one 1/2" per back
         3) #T-55019; "5 Square" outlet box, knockouts: one 1/2", + two 1" per side, one 1/2" per back
         4) #T-55057; "5 Square" outlet box with side mounting bracket, knockouts: one 1" + one 1-1/4" on 3 sides, one 1/2" per back
         5) #T-55058; "5 Square" outlet box with side mounting bracket, knockouts: one 1/2", + one 3/4" + one 1" on 3 sides, one 1/2" per back
         6) #T-55059; "5 Square" outlet box with side mounting bracket, knockouts: one 1/2", + two 1" on 3 sides, one 1/2" per back
         7) #R-55000; blank cover for "5 Square" outlet box
         8) #N-54000; 4"-sq cover for "5 Square" outlet box, flat
         9) #N-54012; 4"-sq cover for "5 Square" outlet box, 1/2" raised
        10) #N-54058; 4"-sq cover for "5 Square" outlet box, 5/8" raised
        11) #N-54034; 4"-sq cover for "5 Square" outlet box, 3/4" raised
        12) #N-54010; 4"-sq cover for "5 Square" outlet box, 1" raised
        13) #N-54114; 4"-sq cover for "5 Square" outlet box, 1-1/4" raised
        14) #N-54112; 4"-sq cover for "5 Square" outlet box, 1-1/2" raised
        15) #D-51G000; one gang cover for "5 Square" outlet box, flat
        16) #D-51G012; one gang cover for "5 Square" outlet box, 1/2" raised
        17) #D-51G058; one gang cover for "5 Square" outlet box, 5/8" raised
        18) #D-51G034; one gang cover for "5 Square" outlet box, 3/4" raised
        19) #D-51G010; one gang cover for "5 Square" outlet box, 1" raised
        20) #D-51G114; one gang cover for "5 Square" outlet box, 1-1/4" raised
        21) #D-52G000; two gang cover for "5 Square" outlet box, flat
        22) #D-52G012; two gang cover for "5 Square" outlet box, 1/2" raised
        23) #D-52G058; two gang cover for "5 Square" outlet box, 5/8" raised
        24) #D-52G034; two gang cover for "5 Square" outlet box, 3/4" raised
        25) #D-52G010; two gang cover for "5 Square" outlet box, 1" raised
        26) #D-52G114; two gang cover for "5 Square" outlet box, 1-1/4" raised
      b. Or equal

E. Square Box – 4-11/16", Deep
   1. Dimensions: 4-11/16 in square x 2-1/8 in deep
   2. Volume: 42 in³
   3. Box shall have standard 4-11/16 screw pattern (accept standard 4-11/16" covers/mud rings/tile covers/etc).
   4. Manufacturers:
      a. Appleton Electric Co and/or O-Z Gedney (Emerson Electric Co)
      b. Garvin Industries #72171-1-1/4 drawn 4-11/16"S x 2-1/8"D box, (4) 1-1/4" KOs
      c. RACO (Hubbell Electrical Products)
      d. Steel City (Thomas & Betts)
      e. Or equal
2.5 BOX SUPPORT ACCESSORIES

A. Box accessories shall comply with UL standards and shall be listed by a nationally recognized testing laboratory.

B. Stud-Mount Single-Box Bracket
   1. Rico #SGBS16A; stud-mount bracket, for 1-1/2" or 2-1/8"D box, fits 16" stud spacing
   2. Rico #SGBS24A; stud-mount bracket, for 1-1/2" or 2-1/8"D box, fits 24" stud spacing
   3. Garvin #BMB16218; stud-mount bracket, for 2-1/8"D box, fits 16" stud spacing
   4. Garvin #BMB16350; stud-mount bracket, for 3-1/2"D box, fits 16" stud spacing
   5. Garvin #BMB24218; stud-mount bracket, for 2-1/8"D box, fits 24" stud spacing
   6. Garvin #BMB24350; stud-mount bracket, for 3-1/2"D box, fits 24" stud spacing
   7. Garvin #BMB16SL; stud-mount bracket, 'sliding' position for 1-1/2" or 2-1/8" D box, fits 16" stud spacing
   8. Garvin #BMB24SL; stud-mount bracket, 'sliding' position for 1-1/2" or 2-1/8" D box, fits 24" stud spacing
   9. Raco #9004; fixed stud-mount bracket, for 2-1/8"D box, fits 16" stud spacing
  10. Raco #9006; fixed stud-mount bracket, for 2-1/8"D box, fits 24" stud spacing
  11. Raco #9013; adjustable stud-mount bracket, for 2-1/8"D box, fits 10-3/8" to 18" stud spacing
  12. Raco #9015; adjustable stud-mount bracket, for 2-1/8"D box, fits 15" to 26" stud spacing

C. Stud-Mount Multi-Box Bracket
   1. Rico #RBS16; stud-mount bracket, 3 positions for 4S and/or 4-11/16"S box, fits 16" stud spacing
   2. Rico #RBS24; stud-mount bracket, 4 positions for 4S and/or 4-11/16"S box, fits 24" stud spacing
   3. Garvin #BMB4S3P; stud-mount bracket, 3 positions for 4S and/or 4-11/16"S box, fits 16" stud spacing
   4. Raco #9002; stud-mount bracket, 3 positions for 4S and/or 4-11/16"S box, fits 16" stud spacing
   5. Raco #9002; stud-mount bracket, 4 positions for 4S and/or 4-11/16"S box, fits 24" stud spacing

D. Floor-Mount Box Mounting Bracket
   1. Rico #FMBS18; floor mount support bracket for box, puts box at 18.5" above wall footer
   2. Garvin #KP4-12; floor mount support bracket for 4S and/or 4-11/16"S box, puts box at 12" above wall footer
   3. Garvin #KP4-18; floor mount support bracket for 4S and/or 4-11/16"S box, puts box at 18" above wall footer
   4. Garvin #KP4-24; floor mount support bracket for 4S and/or 4-11/16"S box, puts box at 24" above wall footer
   5. Raco #9009; floor mount support bracket for 4S and/or 4-11/16"S box, puts box at 12" above wall footer
   6. Raco #9010; floor mount support bracket for 4S and/or 4-11/16"S box, puts box at 18" above wall footer

E. T-Bar Bracket
   1. Rico #510HD; bracket for outlet box, attaches to T-bar ceiling grid

F. T-Bar Support
   1. Rico #4ACS; adapter/support for outlet box, attaches to T-bar ceiling grid
2.6 FIRE RATED SLEEVE

A. Application: Suitable as a sleeve for cables to pass through a full-height partition or floor, and as a through-penetration fire stop system maintaining the fire rating of the penetrated partition.

B. Sleeve system shall be tested in accordance with ASTM E 814 (ANSI/UL1479).

C. Sleeve system shall be UL Listed and shall bear a UL Classification marking.

D. Sleeve system shall match (or exceed) the partition’s/floor’s F and T rating.

E. Manufacturers:
   1. Hilti
      a. #236323; “CP 653 Speed Sleeve”, 2-inch round sleeve kit
      b. #236324; “CP 653 Speed Sleeve”, 4-inch round sleeve kit
   2. Specified Technologies Inc (STI)
      a. #EZD22; “EZ Path Series 22”, 2-inch square sleeve kit #EZDP33FWS; “EZ Path Series 33” 3-inch square sleeve kit
      b. #EZDP233GK; “EZ Path Series 33” 2 gang 3-inch square sleeve kit
      c. #EZDP333GK; “EZ Path Series 33” 3 gang 3-inch square sleeve kit
      d. #EZDP433GK; “EZ Path Series 33” 4 gang 3-inch square sleeve kit
      e. #EZDP733GK; “EZ Path Series 33” 7 gang 3-inch square sleeve kit
      f. #EZDP133CK; “EZ Path Series 33” 3-inch square sleeve kit with circular wall plates
      g. #EZDP133CWR; “EZ Path Series 33” 3-inch square sleeve kit with retrofit/repair wall plates
      h. #EZDP133FK; “EZ Path Series 33” 3-inch square sleeve kit with kick plate
      i. #EZDP133CAK; “EZ Path Series 33” 3-inch square sleeve kit with attach plates for 4-inch conduit
      j. #EZD33FWS; “EZ Path Series 33” 3-inch square sleeve
      k. #EP133W; “EZ Path Series 33” wall plates (1 pair) for EZD33FWS sleeve
      l. #EP233W; “EZ Path Series 33” wall plates (1 pair) for EZD33FWS sleeves
      m. #EP333W; “EZ Path Series 33” wall plates (1 pair) for 3 EZD33FWS sleeves
      n. #EP433W; “EZ Path Series 33” wall plates (1 pair) for 4 EZD33FWS sleeves
      o. #EP733W; “EZ Path Series 33” wall plates (1 pair) for 7 EZD33FWS sleeves
      p. #EP133CW; “EZ Path Series 33” circular wall plates (1 pair) for EZD33FWS sleeve
      q. #EP133K; “EZ Path Series 33” kick plate for EZD33FWS sleeve
      r. #EP133CA; “EZ Path Series 33” attach plates (1 pair) to 4-inch conduit for EZD33FWS sleeve
      s. #EP133CR; “EZ Path Series 33” repair/retrofit wall plates (1 pair) for EZD33FWS sleeve
      t. #EP133PC; “EZ Path Series 33” positioning clamps for EZD33FWS sleeve
      u. #EZD33E; “EZ Path Series 33” extension kit for EZD33FWS sleeve
      v. #RCM33; radius drop out for “EZ Path Series 33” sleeve
      x. #EZDP44; “EZ Path Series 44” 4-inch square sleeve kit
      y. #EZDP144FK; “EZ Path Series 44” 4-inch square sleeve kit with kick plate
      z. #EZDG44; “EZ Path Series 44” 4-inch square kit with 4 sleeves and 1 grid
      aa. #EZD44; “EZ Path Series 44” 4-inch square sleeve
      bb. #EP144W; “EZ Path Series 44” wall plates (1 pair) for EZD44 sleeve
      cc. #EP544W; “EZ Path Series 44” wall plates (1 pair) for up to 5 EZD44 sleeves
      dd. #EP144K; “EZ Path Series 44” kick plate for EZD44 sleeve
      ee. #EZR44; “EZ Path Series 44” grid for 8 sleeves
      ff. #EZR44; “EZ Path Series 44” grid for 16 sleeves
      gg. #TRK444; T-rating kit, for 4 Series 44 sleeves
2.7 SPIRAL WRAP

A. Application: Suitable for an indoor installation for the support of telecommunications cables from a feed pathway to furniture systems, or similar.

B. Material shall be flame retardant polyethylene (UL94V-0), or equivalent.

C. Color: Black.

D. Size: As required to support the given cable bundle size (e.g., 3/4" minimum).

E. Manufacturers:
   1. Panduit
   2. Or equal

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

A. Prior to starting the work of this section, examine areas to receive pathways systems to verify conditions are ready for work and to verify conformance with manufacturer and specification tolerances. Notify the Owner's Representative in writing of conditions that would adversely affect the installation, or subsequent utilization, of the system. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Prior to installation, plan routes and locations of pathway systems and coordinate with other trades (ductwork, plumbing, electrical raceways, wall construction, ceilings, etc.). Pathway systems shall not unnecessarily cross other trade's work, shall not prevent removal of ceiling tiles or panels, and shall not block access to mechanical or electrical equipment. Provide offsets as required to avoid obstruction of pathway systems with other trades.

3.3 INSTALLATION

A. Secure raceway/pathway systems to building structures using approved support methods and components (fasteners, anchors, clamps, hangers, etc) and complaint to the CEC.

B. Conduit Systems, including Pull Boxes
   1. Run conduit in groups/banks in the most direct route possible, parallel to building lines, and at elevations that avoid unnecessary offsets. Do not route conduit through areas in which flammable material may be stored, or over or adjacent to boilers, incinerators, hot water lines, or steam lines. Completed conduit systems installation shall not encroach into the ceiling height headroom of walkways or doorways.
   2. Trapeze Supported Conduit Runs
      a. Support conduit runs using "trapeze" hangers fabricated from construction channel and threaded steel rods anchored to building structures. Fasten conduit to construction channel using standard conduit clamps or equivalent.
b. Seismically brace trapeze supports compliant to applicable codes.

3. Surface-Mounted Conduit Runs
   a. Single Conduit Runs: Support single conduit runs to building structure using construction channel with approved anchors and hardware or using 2-hole (preferred) or 1-hole conduit straps (or similar support apparatus). Where installed in damp or wet locations, support conduit to building structure using conduit clamp such that clamp backs add space between conduit and mounting substrate.
   b. Multiple Conduit Runs: Support multi-conduit runs to building structure using construction channel with approved anchors and hardware. Select anchors based on installation substrate. Fasten conduit to construction channel using standard conduit clamps or equivalent.
   c. Install vibration control apparatus as required to meet isolation requirements.

4. Install conduit free from dents, bruises or deformations. Remove and replace damaged conduits with new undamaged material.

5. Install metallic conduit so as to not be in contact with other dissimilar metal pipes (e.g., plumbing) to minimize galvanic corrosion.

6. Make bends and offsets using standard conduit bending hand tool and/or machines or use factory fittings. The use of any item not specifically designed for bending conduit is strictly prohibited.

7. For conduits that turn up and protrude from finished concrete, extend conduits 25mm – 75mm (1" to 3") above the surface of the floor, unless conditions require other extension lengths.

8. Pull Boxes: Install pull boxes and junction boxes at locations that are accessible. Install pull boxes and junction boxes at locations that are concealed, unless as noted on drawings; pull boxes and junction boxes may be exposed in electrical rooms, utility rooms, storage areas, or when installed in ‘open’ spaces (such as no ceilings). Adjust locations and installation as coordinated with construction conditions and as required for seismic bracing. Within ceiling space (e.g., above ceiling grid), do not install higher than 1m (~3') above grid.

9. Ream conduit ends cut in the field (non-factory) to eliminate sharp edges, burrs, etc.

10. Clean completed conduits of foreign matter and/or moisture (e.g., pull a bristle mandrel through).

11. Secure pull strings/mule tapes at conduit ends or within boxes to prevent recoiling back into duct.

12. After installation of conduit system and during ongoing general construction, protect conduits and tightly cover/seal open ends.

13. Leave no unused openings in any pull or junction box. Install close-up plugs as required to seal openings.

14. Label each conduit end in a clear manner by designating the location of the other conduit end (i.e. room name, junction box number, etc.). Indicate conduit length on the label.

15. For connections to equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission, use short length (maximum of 6ft) of the FMC or LFMC conduit. For installation in exterior locations, or humidity-laden atmosphere, corrosive atmosphere, water hose or spray wash down operations, and locations subject to seepage or dripping of oil, grease or water, use LFMC. Provide a green ground wire with FMC or LFMC conduit.

16. Terminations, Connections and Joints
   a. Securely connect conduits to boxes, cabinets, wireways, etc., using conduit connectors suitable for the application and one (or two) locknuts and, where required, an insulating bushing or insulated connectors. Torque threaded items to proper tightness.
   b. Where conduits are bonded to ground, securely attach grounding bushings and route bonding jumpers in as short of a path as possible to grounding point.
   c. Where joints and/or connections cannot be made tight, use a bonding jumper to maintain electrical continuity through the connection.
d. Where terminations are subject to vibration, use a bonding bushing or wedge to maintain electrical continuity through the connection. Where subject to vibration or dampness, use insulating bushings to protect conductors.

C. Outlet Boxes / Back Boxes
   1. Install boxes plumb and square. Match heights of surrounding outlets (e.g., an adjacent electrical receptacle). Adjust locations and heights as required to suit coordination requirements of construction conditions.
   2. Install boxes flush with walls, ceilings and floors except where exposed work is called for on the drawings, required, or appropriate.
   3. Do not make unused openings in boxes (such as knocking out fabricated knock-outs without using the opening for a conduit connector). Replace boxes containing inadvertent or unused openings.
   4. Framed Walls, both Fire Rated and Non-Rated
      a. Install outlet boxes and covers/raised rings during rough-in such that the finished condition is flush with wall finishes.
      b. Do not install outlet boxes back-to-back (outlet boxes facing opposite sides of a wall). At framed walls not fire rated, install boxes with at least 6" separation. At fire rated framed walls, install boxes with at least 24" and 1 framing stud separation.
      c. Patch/repair openings in wall (plaster, drywall, and/or plasterboard) around boxes and/or raised rings to eliminate visible gaps after outlet gets finished, in accordance with CEC 314.21.
   5. Ceilings
      a. At ceilings, install boxes, supports (such as T-bar support bracket), and cover/ring such that the finished condition is flush with ceiling finishes, except where noted otherwise and where conditions prevent a flush installation
      b. At non-accessible ceilings, install service conduit continuous to an accessible location

D. Fire Rated Sleeve
   1. Install the sleeves in strict accordance with the UL System drawing, with the approved shop drawings, and with the equipment manufacturer's instructions.
   2. Framed Walls – Pre-Framed and Cut-In
      a. Coordinate location of penetration with other trades such as framing (wall studs), electrical (lighting), mechanical (ducts), and other trades.
      b. For cut-in instances, cut wallboard to fit rated sleeve system – no more wallboard than is necessary to fit the system.
      c. Apply the factory-supplied gasket prior to the installation of the wall plates.
      d. Secure wall plates to sleeves per the equipment manufacturer’s recommendations.
   3. Affix a label at each fire sleeve location onto the wall or floor – within 2 to 3 feet. Place label in a location that will not be obscured after cables get installed through the sleeve. Label shall describe the system's applicable ratings, such as F, T, and L ratings.

3.4 FINAL INSPECTION AND CERTIFICATION

   A. Punch the Work of this Section compliant to the requirements of Section 270000.
   B. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION
SECTION 270811
COMMUNICATIONS TWISTED PAIR TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Testing of Communications Twisted Pair Cabling.

B. Related Sections
   1. Comply with the Related Sections paragraph of Section 270000.
   2. Section 271513 - Communication Horizontal Twisted Pair Cabling

1.2 REFERENCES

A. Comply with the References requirements of Section 270000.

B. In addition to the References of Section 270000, the following references apply to this specification:
   1. ANSI/TIA-1152, "Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling"

1.3 DEFINITIONS

A. Refer to Definitions of Section 270000 and Section 271513.

B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:
   1. "CAT6A": Shall mean Augmented Category 6 cabling, per ANSI/TIA-568-C.2
   2. "Channel": Shall mean a testing configuration which includes the Permanent Link and the line cord (at the workstation), the equipment cord, and, if a full crossconnection is implemented, a patch cord and the crossconnect termination/connecting apparatus.
   3. "Connect": Shall mean install all required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.
   4. "Cord": Shall mean a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper" and "Lead".
   5. "Permanent Link": Shall mean the ‘permanent’ portion of the Horizontal cabling to each outlet with the test cords de-embedded from the measurements; this includes cable, consolidation point (if used), termination/connecting apparatus in the IDF and the connector at the outlet.
   6. "System Cord": Shall mean the cord used in the operating transmission circuit.
   7. "Test Cord": Shall mean the cord certified for use in testing, as described in this section.

1.4 SYSTEM DESCRIPTION

A. Refer to Section 270000 and Section 271513 for addition system description information.

B. Work Provided Under Other Sections
   1. Horizontal twisted pair cabling

C. Base Bid Work
   1. Testing of a completed communication infrastructure cabling system, which includes:

27 08 11 - 1
a. Submittals
b. Testing of the twisted pair cabling as follows:

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Type</th>
<th>Test</th>
<th>Configuration</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal</td>
<td>CAT6A</td>
<td>Category 6A</td>
<td>Permanent Link</td>
<td>Per TIA-568-C.2, 6.3</td>
</tr>
</tbody>
</table>

c. Record Documents, including test results.

1.5 SUBMITTALS

A. Comply with the Submittal requirements of Section 270000.

B. Submittal Requirements at Start Of Construction:
   2. Product Submittal, including cut sheets of testing equipment to be used (note all software/ firmware versions as applicable).
   3. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for Division 27.

C. Submittal Requirements at Closeout:
   1. Record Documents:
      a. Submit one hard copy and one soft copy of test reports, including all tested parameters.
      b. Submit one hard copy of warranty certificate.
   2. Format – Hard Copy:
      a. Prints of test reports, on 8.5"x11" paper, color or black & white, one cabling link per page
      b. Assemble prints into a 3-ring binder
      c. Clearly label the cover of each test reports binder with the following information:
         1) Client Name
         2) Project Name and Address
         3) Binder Name (e.g., "Test Reports for Horizontal Cabling System")
         4) Date of Submittal – date format: <month> <day>, <year> (e.g., “January 1, 2012”)
         5) Contractor Name
   d. Include a Table Of Contents at the beginning that lists the contents
   e. Organize the test reports by floor, and by TR.
   f. Sort reports in ascending cable ID order
   g. Include tabbed separators for improved navigation through the manual
   3. Format – Soft Copy:
      a. "Burn" onto one CD-ROM test report files as native data format (for example, an *.FLW file from a Fluke tester); if not possible to submit in native format, then issue test results as an exported Microsoft Excel compatible format.
      b. Include onto CD-ROM ‘Viewer’ software necessary to view, sort, filter, and print individual and summary test results from test results native format.
      c. Clearly label the CD-ROM with the following information:
         1) Client Name
         2) Project Name and Address
         3) CD-ROM Name (e.g., "Test Reports for Horizontal Cabling System")
         4) Date of Submittal – date format: <month> <day>, <year> (e.g., “January 1, 2012”)
         5) Contractor Name

1.6 QUALITY ASSURANCE

A. Comply with the Quality Assurance requirements of Section 270000.
B. Under no circumstances shall any cable's and/or conductor's test results be substituted for another's. If an instance of falsification is confirmed, the Contractor is liable for a complete retest of the cabling system at no additional cost to the Owner. This includes the retaining the services of a neutral party to observe all retesting.

1.7 WARRANTY

A. Warrant the validity of the test results.

PART 2 - PRODUCTS

2.1 CATEGORY 6A HORIZONTAL CABLE TESTER

A. Equipment shall be independently verified to meet ANSI/TIA-1152 requirements, including Level IIe minimum accuracy. Equipment shall meet ISO/IEC Class C, D, E, and F.

B. Test Standards (minimum): ANSI/TIA-568-C.2 Category 6A; ISO/IEC 11801 Class C and D; ISO/IEC 11801-2000 Class C and D, 1000Base-T, 100Base-TX; IEEE 802.3 10Base-T; ANSI TP-PMD; IEEE 802.5

C. Areas of Test Measurement (minimum): test areas listed under ANSI/TIA568-C.2, 6.3

D. Equipment:
   1. Fluke Networks
      a. #DTX-1800; "CableAnalyzer" test kit (main unit, remote unit, CAT6A permanent link adapters, CAT6A channel adapters, accessories), loaded with the latest firmware version.
      b. "LinkWare“ reporting and latest version of documentation software

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Calibrate test sets and associated equipment per the manufacturers printed instructions at the beginning of each day's testing and after each battery charge. Fully charge the test sets prior to each day's testing to ensure proper operation.

B. Ensure test equipment and test cords are clean and undamaged during testing activities. Per the Engineer's discretion, halt testing activity and clean testing equipment, test cords, and related apparatus.

3.2 HORIZONTAL CATEGORY 6A TESTING PROCEDURES

A. Precautions
   1. Adhere to the equipment manufacturer's instructions during all testing.
   2. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature - approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
   3. Fully charge power sources before each day's testing activity

B. Test Equipment Set Up
1. Set up the tester to perform a full CAT6A test, as a Permanent Link configuration.
2. If the tester has cable-specific test parameters pre-loaded, set up the tester as product-specific setting. If not, set as generic CAT6A.
3. Set the tester to save the full test results (all test points, graphs, etc.).
4. Save the test results with the associated cable link identifier.
5. Calibrate the test set per the manufacturer's instructions.

C. Acceptable Test Result Measurements
   1. Overall Test Results:
      a. The Owner shall accept only individual test results that result in a Pass.
      b. Links which report a Fail, Fail* or Pass* for any of the individual tests shall result in an overall link Fail.
      c. Any reconfiguration of link components required as a result of a test Fail, must be re-tested for conformance.
      d. Remove and replace any cabling links failing to meet the criteria described in this specification, at no cost to the Owner, with cables that prove, in testing, to meet the minimum requirements.

   2. Wire Map: Correctly terminate all pairs of the cabling link at both ends. Provide only continuous pairs. No exceptions.

   3. Length: Eighty-five meters (279 feet) is the maximum acceptable electrical length measurements for any cabling link measured under a Permanent Link configuration, including test cords.

   4. Insertion Loss: The acceptable insertion loss measurements for any CAT6A cabling link is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

   5. Worst Pair-to-Pair Near End CrossTalk (NEXT) Loss: The acceptable worst pair-to-pair NEXT loss for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

   6. Power Sum NEXT Loss: The acceptable power sum PS-NEXT loss for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

   7. Worst Pair-to-Pair ELFEXT and FEXT Loss: The acceptable worst pair-to-pair ELFEXT and loss for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

   8. Power Sum ELFEXT and FEXT Loss: The acceptable PS-ELFEXT and loss for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

   9. Alien Near End CrossTalk (ANEXT) Loss: The acceptable ANEXT loss for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

  10. Alien Far End CrossTalk (AFEXT) Loss: The acceptable AFEXT loss for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

  11. Return Loss: The acceptable return loss measurements for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

  12. Propagation Delay and Delay Skew: The acceptable propagation delay and delay skew measurements for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

D. Record Documents:
   1. Permanently record test results.
   2. Export all of the numerical test results to a single spreadsheet in Microsoft Excel® 2003 (*.xls) or 2007 (*.xlsx) file format.
   3. Submit test results at the conclusion of the testing to the Engineer for approval. Engineer will check these test reports for a format acceptable to the Owner, or Owner’s Representative.
   4. For each Horizontal CAT6A test, record the following information:
      a. Project name and address
      b. Testing Company’s and Operator’s name
c. Date of measurement
d. Test equipment, including the following:
   1) Manufacturer, model, and serial number
   2) Date and time of last calibration
e. Identification number of cable
f. Overall test result

END OF SECTION
SECTION 271100

COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Buildout / fit-up of communications equipment rooms.

B. Related Divisions and Sections
1. Comply with the Related Sections paragraph of Section 270000.
2. Review Seismic Calculation requirements, specifically in Section 270000, Article 1.05.
3. Drawings, general provisions of the Agreement, and Division 01 apply to this Section.
4. Consult other Divisions, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.

1.2 REFERENCES

A. Comply with the References requirements of Section 270000.

B. In additional to those codes, standards, etc., list in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
1. EIA/EECA-310-E, "Cabinets, Racks, Panels, and Associated Equipment"
2. NFPA National Fire Protection Association (NFPA) 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials

1.3 DEFINITIONS

A. Definitions as described in Section 270000 shall apply to this section.

B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:
1. "UPS": Uninterruptible Power Supply – a system that provides conditioned power with batteries acting as a continuous power source for equipment during a utility power interruption

1.4 SYSTEM DESCRIPTION

A. General: Communications rooms shall fall into one of the following space titles:
1. Intermediate Distribution Facility (IDF)

B. Room Functions:
1. Intermediate Distribution Facilities (IDF) will serve the following functions:
a. House intrabuilding twisted pair and fiber optic backbone cabling from MPOE
b. House horizontal termination field – both voice and data – of outlets served from this room (refer to floor plans for area served)
c. House network equipment (i.e. access switch) serving users of the room’s service area

C. Work Covered Under Other Sections
1. Plywood backboards
2. Bonding
3. Grounding busbars
4. Power and cooling
5. Conduit, device boxes, and sleeves

D. Base Bid Work
1. The Work under this section includes materials, accessories, fasteners, etc., and the labor and associated services required for the buildout / fit-up of telecommunications equipment rooms, and includes coordination through the General Contractor with other trades
2. In general, the Work includes the following:
   a. Submittals
   b. Plywood backboards
   c. Rack bays (equipment racks, vertical management sections, anchoring)
   d. Cable, wire and patch cord management
   e. Overhead and vertical cable support
   f. Seismic bracing
   g. Identification tags and labeling
   h. Record Documents
   i. Warranty

E. Coordination Requirements
1. Existing Equipment:
   a. IDF-253 is an existing room that is to remain in continuous operation, with functional power, cooling, and telecommunications cabling throughout the duration of construction. The room must be protected from dust and debris during construction in order to prevent damage to cabling and network equipment. Work in and around this room needs to be coordinated with the Owner prior to starting work.
   b. IDF-241 is a new room that will be built-out using existing equipment. The new room must be built-out prior to disconnecting or moving the existing equipment. Coordinate with the Owner regarding sequencing of this work.
2. Electrical: Coordinate layout with electrical contractor to ensure proper placement of lighting, sequencing of power service to rack bay, and other issues related to electrical trade.
3. Owner: Coordinate room-ready requirements and schedule with Owner (to allow Owner to plan and execute installation of OFOi telecommunications/network equipment).

1.5 SUBMITTALS

A. Comply with the Submittal requirements of Section 270000.

B. Quantity: Furnish quantities of each submittal as noted in Section 270000.

C. Submittal Requirements at Start of Construction:
1. Product Data Submittal
2. Shop Drawings Submittal: Consisting of any proposed changes to room plans.
3. Sample Submittal: Submit sample of equipment rack label.
4. Seismic Calculations: Rack anchorage into concrete flooring with overall rack bracing, based on maximum rated load capacity.
5. Schedule Submittal: Submit proposed schedule of work (this schedule may be combined with the schedule developed for Division 27).
D. Submittal Requirements at Close Out:
   1. As-Built Drawings Submittal

E. Substitutions
   1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.

1.6 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

A. Warrant Work to perform as described within this Section for a period of 1 year. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 SHEET HARDWOOD / PLYWOOD (AS BACKBOARD)

A. A HP Grade A Type II (graded in accordance with AWI Premium)

B. Materials shall comply with performance requirements in AWPA C27.

C. The backboard must be 8’ x 4’ virgin plywood sheets, free from defects, and be fire rated.

D. Fire-Retardant Treatment Processes: Plywood shall be chemically treated and pressure impregnated, capable of providing a maximum flame spread classification of 26-75 and a smoke density no greater than 450, in accordance with ASTM E 84.

2.2 FASTENERS, FOR PLYWOOD

A. Bolts:
   1. Bolts shall be steel and shall comply with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6).
   2. Hex nuts and flat washers shall comply with ASTM A 563 (ASTM F 563M).

B. Concrete Anchors:
   1. Expansion anchor bolt and sleeve assemblies shall have a capability to sustain, without failure, a load equal to 6 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing inspecting agency.
   2. Materials:
      a. Carbon-steel components, zinc plated to comply with ASTM B 633 Class Fe/Zn 5
      b. Galvanized machine screws or bolts with standard expansion-shield type concrete anchors
   3. Manufacturers:
      a. Phillips Drill Co. “Red Head” masonry anchors
2.3 EQUIPMENT RACK – 2-CHANNEL TYPE

A. Application: Suitable for the support of termination apparatus, cable and cord management apparatus, network equipment, and other similar equipment, within a telecommunications room.

B. Material: High strength, lightweight 6061-T6 aluminum, extrusion construction.

C. Channel:
1. Size: 3" deep, with flanges on each side ("double sided")
2. Flange: 1.265" wide by 0.25" thick, with mounting holes
4. Threading: #12-24 rolled, compatible with EIA-310
5. RMU Markings: The RMU markings shall be permanently stamped on the 'outside' of both flanges on both channels.

D. Assembled Rack: Rack shall be complete with two mounting channels, two base angles (3.5" high by 6" deep by .375" thick), two top angles (1.5" high by 1.5" deep by .375" thick), and hardware. Assembled rack shall be 7'-0" high (overall) by 19" mounting width (20.25" wide overall), and shall contain 45 EIA mounting spaces (1.75")

E. Load Rating: See structural calculations for load rating.

F. Finish: Black, powder coat

G. Manufacturer:
1. CPI
   a. #46353-703; 7'-0"H x 19" 2-channel equipment rack, 45 RMU, black
2. Or equal

2.4 SEISMIC GUSSET, FOR 2-CHANNEL EQUIPMENT RACK

A. Application: Seismic gusset kit for stiffening and stabilization of critical joints in equipment racks.

B. Manufacturer:
1. CPI
   a. #11592-701; gusset kit, black
2. Cooper B-Line
   a. #SB556 GUSSET KIT FB; gusset kit, black
3. Or equal

2.5 VERTICAL MANAGEMENT SECTIONS

A. Application: Suitable for cable routing, cord routing, and cord slack storage vertically (between the top and bottom) within a rack bay.

B. The vertical management section shall be double-sided (i.e., the management section having covered cable guides on the front and flip-retainers on the rear).
C. Mounting: The vertical management section having matching bolt holes for attachment to the rack.

D. Color: black (guides and cover).

E. Manufacturer:
   1. CPI
      a. #12096-703; vertical management section, 7'-0" x 3.65", double sided, black
      b. #11729-703; vertical management section, 7'-0" x 6", double sided, black
      c. #30162-703; 7'-0"H x 6"W, "CCS" double sided, black
   2. Or equal

2.6 HORIZONTAL MANAGEMENT PANEL

A. Application: Suitable for installation into equipment rack for horizontal cord management. The horizontal management panel shall match (and fully integrate with) the vertical management sections.

B. The horizontal management panel shall be single-sided.

C. Size: 1U or 2U high by 19" mounting wide.

D. Color: black (guides and cover).

E. Manufacturer:
   1. CPI
      a. #30139-719; horizontal management panel, single sided, 1U, black
      b. #30130-719; horizontal management panel, single sided, 2U, black
   2. Panduit
      a. #NCMHF2; horizontal cable manager with removable hinged front cover, front only, 2U
      b. #NCMHF1; horizontal cable manager with removable hinged front cover, front only, 1U
   3. Or equal

2.7 CABLE RUNWAY

A. Cable Runway Straight Sections
   1. Application: Suitable for the support & management of telecommunications (and other low voltage) cables, either overhead or mounted vertically on a wall, within Telecommunications Room. Also overhead equipment rack bracing.
   2. Construction: Constructed of two longitudinal side elements – "stringer", with elements periodically crossing between stringers – "rung"; Rungs spaced 12" on center, and welded to stringer.
   3. Material (both stringer and rung): Steel tube, rectangular, 1-1/2" by 3/8" by 0.65" wall thickness.
   4. Size: 9' 11-1/2" straight sections; width: refer to Drawings.
   5. Manufacturers:
      a. CPI
         1) #10250-712; 12"W cable runway, black
         2) #10250-718; 18"W cable runway, black
      b. Cooper / B-Line
         1) #SB17U12BFB; 12"W cable runway, black
         2) #SB17U18BFB; 18"W cable runway, black
   c. Or equal
2.8 LABEL PLATES, FOR EQUIPMENT RACKS

A. Label plate shall be suitable to affix onto top angle of equipment rack or onto the top front of a frame/cabinet.

B. Label plate shall be ‘engrave-able’ stock melamine plastic laminate substrate.

C. Size (minimum): 1/2-inch high by 6 inches long by 1/16-inch thick.

D. Color: Black.

E. Lettering shall be white, engraved, 1/8-inch high.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

A. Prior to installation, verify equipment rooms are suitable for the construction scope of this section. Schedule work to prevent damage caused by other trades during the course of that other construction.

B. Prepare surfaces, such as floors, for permanent installation of products, such as racks.

3.3 INSTALLATION

A. Plywood Backboards
   1. General
      a. Complete installation work in a neat, high quality manner and conform to all applicable federal, state and local codes, and all telephone standards.
      b. Replace or repair work completed by others that is defaced or destroyed by Work associated with installation of the plywood backboards. Contractor shall pay for the full cost of this repair/replacement.
   2. Preparation
      a. Condition wood materials to average prevailing humidity conditions in installation areas prior to installing.
      b. Discard all units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
   3. Plywood
      a. Install plywood in accordance with WIC Custom or Premium Quality Standard, as scheduled. Ensure work complies with applicable codes and recognized standards.
      b. Install plywood as indicated on Drawings to the dimensions shown. In lieu of no dimensions, install plywood from +0'-6" to +8'-6" above the finished floor.
      c. Install plywood plumb, level, true, and straight with no distortions. Shim as required using concealed shims.
      d. Trim plywood around electrical and telecommunications outlets.
      e. Install plywood such that the fire rating stamp is visible.
f. Install plywood to a tolerance of 1/8 inch in 8 feet for plumb and level; and with 1/16 inch maximum offset in flush adjoining, 1/8 inch maximum offsets in revealed adjoining surfaces.

4. Fasteners
   a. Install plywood using bolts, concrete anchors, or other fasteners suitable for the purpose.
   b. Provide nails, screws, anchors and other anchoring devices of the type, size, material, and finish required for application/mounting substrate.
   c. Do not use aluminum fasteners.
   d. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.

5. Painting
   a. Paint plywood backboards with a low-gloss, white (or similar bright color) paint.
   b. Mask the plywood's fire rated symbol/stamp from the paint such that the symbol/stamp is still visible after painting.

6. Cleaning, Finishing, and Protection
   a. Cleaning: Clean finish carpentry work on exposed and semi-exposed surfaces. Touch-up shop-applied finishes to restore damaged or soiled areas.
   b. Protection: Protect and maintain protection to ensure work will be without damage or deteriorating at time of acceptance.

B. Rack Bays
   1. Equipment Racks
      a. Provide parts and accessories required to complete each rack. Completely assemble racks, according to manufacturer's instructions.
      b. Anchoring/Bracing
         1) Use concrete anchors approved by structural engineer.
         2) Anchor racks to the structural floor at four points.
         3) If required for seismic bracing, provide bracing devices (e.g., brackets, threaded rod with strut, etc.) attached to the wall or structure above using appropriate fasteners.

   2. Vertical Management Sections
      a. Provide vertical management sections as shown on Drawings. If not shown, provide a default of one vertical management section between each rack and at either end of the bay.
      b. Bolt vertical management sections to the equipment racks at the points designed by the manufacturer and per the manufacturer's installation instructions.

   3. Tolerances:
      a. Equipment Rack: Verify dimensions to establish proper clearances as follows:
         1) Front: 40" clearance from channel's front mounting flange.
         2) Back: 57" clearance from channel's back mounting flange.
      b. Provide the correct amount of space between each rack for proper installation (according to manufacturer's written instructions) of the vertical management sections.

   4. Horizontal Management Panels
      a. Provide horizontal management panels as shown on Drawings. If not shown, provide one management panel above each patch panel and on below the bottom patch panel in each rack bay where patch panels occur.
      b. Provide fasteners and parts required to complete the installation.

   5. Accessories
      a. Provide rack mounting screws – 1 bag of screws per rack, as come packaged with the rack product. Attach the screws directly to the rack (visible for the punch walk). This shall constitute turn-over to the Owner.

C. Overhead Cable Support
1. Provide support devices (e.g., brackets and threaded rod with strut) for overhead cable management system; install per the manufacturer's instructions and fastened to the wall or ceiling using appropriate fasteners.
2. Provide parts required for complete installation (e.g., mounting brackets, splice kits, hardware, etc.).
3. Tolerances
   a. Install overhead cable support centered over the equipment rack, or as shown on the Drawings.
4. Interface with Other Work: Coordinate the installation of the overhead cable support with other trades. Trapeze supports and 'hanger rods' ('all-thread'), for example, may be shared to lower overall construction cost.

D. Vertical Cable Support
1. Provide cable runway installed vertically to connect the existing riser pathway to the new cable runway for use to support cables routing vertically within telecommunications rooms.
2. Provide parts required for complete installation (e.g., vertical mounting brackets, bolts, etc.).
3. When using cable runway, install the runway such that the rungs are facing outward (the greater distance from the rung to the stringer edge is facing inward).

3.4 LABELING

A. General Requirements: Labeling and identifier assignment shall conform to ANSI/TIA-606-B and as approved by Owner before installation.

B. Equipment Rack Label Requirements: Provide one label plate per rack. Permanently affix label plate and position as shown on the Drawings; if not shown on the Drawings, center the label plate on the rack's front top angle or the cabinet's top front frame.

C. Identifier Assignment
1. Equipment Racks
   a. Prefix: "RACK"
   b. First field: the room's identifier; for example: "TR2.1".
   c. Second field: the rack number (sequential numeral); for example: "01".
   d. Example: "RACK TR2.1-01"

3.5 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 270000.

B. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION
SECTION 271513

COMMUNICATIONS HORIZONTAL TWISTED PAIR CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Horizontal Twisted Pair Cabling (subsystem of Telecommunications Cabling Infrastructure)

B. Related Sections
   1. Comply with the Related Sections requirements of Section 270000
   2. 270811 Communication Twisted Pair Testing

1.2 REFERENCES

A. Comply with the References requirements of Section 270000.

B. In addition to the codes and standards listed in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
   1. National Fire Protection Agency (NFPA)
   2. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
      a. UL 444, "Communications Cables"
      b. UL 1863, "Communications-Circuit Accessories"
   3. Insulated Cable Engineers Association (ICEA):
      a. ANSI/ICEA S-90-661-2008, "Category 3, 5, and 5e Individually Unshielded Twisted Pair Indoor Cable for Use In General Purpose and LAN Communication Wiring Systems"
      b. ICEA S-102-700-2004, "ICEA Standard For Category 6 Individually Unshielded Twisted Pair Indoor Cables (With Or Without An Overall Shield) For Use In Communications Wiring Systems Technical Requirements"

1.3 DEFINITIONS

A. Refer to Section 270000 for Definitions.

B. In addition, define the following list of terms as used in this specification as follows:
   1. "CAT6A": Category 6 Augmented [UTP] performance grade
   2. "Channel": End to end transmission path; e.g., the entire portion of the horizontal cabling to each outlet consisting of the Permanent Link, line cord (at the workstation), patch cord, and, if a full crossconnection is implemented, the crossconnect termination/connecting apparatus and equipment cord.
   3. "CMP": Communications Media Plenum [NEC plenum rating]
   4. "CMR": Communications Media Riser [NEC riser {non-plenum} rating]
   5. "FEP": Fluorinated Ethylene Propylene
   6. "PE": Polyethylene
   7. "Permanent Link": Test configuration for a horizontal cabling link excluding patch cords, equipment cords, and line cords; e.g., the ‘permanent’ portion of the horizontal cabling to each outlet consisting of cable, consolidation point (if used), termination/connecting apparatus in the telecommunications and the connector at the outlet.
8. "PVC": PolyVinyl Chloride
9. "UTP": Unshielded Twisted Pair

1.4 SYSTEM DESCRIPTION

A. Work Covered Under Other Sections
   1. Pathways: The communications pathways (basketway, conduits, stubs, etc.) work will be covered under another Section. Refer to the contract drawings for size/capacity and route information.
   2. Rooms: Build out (e.g., backboards, overhead and vertical cable runway, etc.) of the telecommunications rooms will be covered under another Section. Refer to the contract drawings for build out information.
   3. Connecting Media: Patch cords in the TRs between horizontal field and network equipment (e.g., access switch), patch/line cords at the work areas between outlet and user equipment (e.g., phone, computer, etc)

B. Base Bid Work
   1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working communications Horizontal Twisted Pair Cabling System installation described in this Section and shown on related drawings. Consider Horizontal Cabling as shown on contract drawings as base bid work, unless otherwise noted. This includes terminations at both ends.
   2. In general, the base bid work includes:
      a. Submittals
      b. Horizontal cables, terminations, and outlets
      c. Cable management
      d. Cable identification tags and system labeling
      e. Record Documents
      f. Warranty

C. Jack Wiring: T568A.

1.5 SUBMITTALS

A. Comply with the Submittals article of Section 270000 for procedural, quantity, content, and format requirements.

B. Substitutions
   1. Conform to substitutions requirements and procedure in Section 270000.

C. Submittal Requirements at Start Of Construction:
   1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
   2. Sample Submittal, consisting of the following components:
      a. Outlet Sample – one fully configured outlet including faceplate, modular jacks, and label
      b. Cable Label Sample
   3. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for 27xxxx series Sections
   4. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations

D. Submittal Requirements at Closeout: [Submit to CCCC IT]
1. As-Built Drawings
2. Cable ID –to– Office Number Key: Submit a “cable ID-to-Office number key” as an electronic file in an MS-Excel spreadsheet file format containing a list of every cable identifier associated with the final office number
3. Crossconnection records/cut sheets
4. O & M Manuals

1.6 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 270000.

B. Contractor Qualifications
   1. In addition to the Contractor Qualifications requirements of Section 270000, the Contractor shall be certified by the manufacturer to provide the cabling system (proposed, submitted, and approved) and to provide an extended warranty. Submit satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

A. The horizontal cabling system, as specified in this section, shall carry a 25-year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover electrical performance of cabling system to the specific category per ANSI/TIA/EIA-568-C performance criteria for horizontal cabling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Panduit cabling system
B. Superior-Essex cabling system

2.2 HORIZONTAL CABLE – CAT6A PLENUM (CMP) RATED

A. Application: Suitable for indoor installation, within ceiling space in primary and secondary pathways.

B. Conductors:
   1. Insulated Conductors: 23 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = FEP, or equivalent).

C. Cable Sheath:
1. Outer Jacket: seamless outer jacket (material = LS-PVC, or similar) applied to and completely cover the internal components (twisted pairs).
2. Flame Rating: NEC (Article 800) rated as CMP, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-C.2, ISO 11801 Class E Edition 2.1, and IEEE Std. 802.3an channel requirements for supporting 10GBASE-T.

E. Manufacturer:
1. Panduit
   a. #PUP6XC04GR-U; CAT6A 4 pair UTP cable “10Gig”, CMP, green
2. Superior Essex
   a. #6H-272-5B; CAT6A 4 pair UTP cable “10Gig XP”, CMP, green

2.3 TERMINATION APPARATUS – MODULAR PATCH PANEL, CAT6A RATED

A. Application: Panels shall be suitable for installation within a telecommunication room (TR) for the termination of the horizontal cables specified herein. Panels shall be horizontally oriented for a rack-mounted configuration. Panels shall be capable of supporting, organizing, labeling and patching/ crossconnecting between the horizontal termination field and the equipment termination field.

B. Modular patch panel shall have 110-type termination, and shall be compatible with the specified horizontal cables both electrically and physically. Modular patch panels shall match the existing product manufacturer and type, where available.

C. Mechanical Performance: Each port shall be an 8-position modular jack, compliant to ANSI/TIA-568-C.2 (2.5.7).

D. Electrical Performance: Each port shall meet or exceed TIA/EIA-568-C.2 6.8 and ISO/IEC 11801 requirements for CAT6A UTP cabling through the cable termination and patch cord connection.

E. Manufacturer:
1. Panduit
   a. #DP486X88TGY; CAT6A modular patch panel “DP6 10Gig”, flat, 48 ports
   b. #DPA486X88TGY; CAT6A modular patch panel “DP6 10Gig”, angled, 48 ports
2. Or equal

2.4 MODULAR CONNECTOR / 8-POSITION JACK – CAT6A RATED

A. Application: Modular connectors (jacks) for termination of 4-pair UTP cables; modular connectors shall be compatible with the 4-pair cables specified herein this section both electrically and physically. Modular connectors shall match the existing product manufacturer, type, and color, where available.

B. Mechanical Performance: Modular jacks shall be 8-position, compliant to ANSI/TIA-568-C.2.

C. Electrical Performance: Each jack shall meet or exceed TIA/EIA-568-C.2 and ISO/IEC 11801 requirements for CAT6A UTP cabling.

D. Manufacturer:
1. Panduit
   a. #CJ6X88TGWH; CAT6A 8-position jack “Mini-Com” series “TX6 10Gig”, White (voice)
b. #CJ6X88TGBU; CAT6A 8-position jack "Mini-Com" series "TX6 10Gig", Blue (data)
c. #CJ6X88TGBL; CAT6A 8-position jack "Mini-Com" series "TX6 10Gig", Black (security)
d. #CJ6X88TGGR; CAT6A 8-position jack "Mini-Com" series "TX6 10Gig", Green (wireless)
e. #CJ6X88TGRD; CAT6A 8-position jack "Mini-Com" series "TX6 10Gig", Red (emergency notification)

2.5 WORK AREA OUTLETS

A. Faceplates for Standard Flush-Mount Outlets
   1. Application: Faceplates shall be suitable for indoor installation for standard 1-gang and 2-gang flush-mount devices. Faceplates shall match the existing product manufacturer, type, and color, where available.
   2. Faceplates shall have 1, 4, or 10 ports, and shall include required accessories, such as icons, blank inserts, label windows and labels.
   3. Color: White
   4. Manufacturer:
      a. Panduit
         1) #CFPE4WHY; faceplate, "Executive Series" series, 1-gang, horizontal, 4 ports, white
         2) #CFPE10WH-2GY; faceplate, "Executive Series" series, 2-gang, horizontal, 10 ports, white

B. Faceplate for Wall Phone Outlets
   1. Application: Faceplates shall be suitable for indoor installation for standard 1-gang flush-mount device equipped with one opening for a keystone jack and two mounting studs for standard wall-mount telephones.
   2. Faceplates shall include required accessories, such as icons, blank inserts, label windows and labels.
   3. Color: Stainless steel
   4. Manufacturer:
   5. Panduit
      1) #KWPY; wall phone faceplate, stainless steel, recessed port

C. Bezel Adapters
   1. Adapters fully compatible with Wiremold’s "Open Systems" devices and Panduit Mini-Com connectors.
   2. Manufacturer:
      a. Panduit
         1) #CHI2MEI-X; bezel adapter, 2 port, accepts Mini-Com connectors
   3. Adapters fully compatible with Wiremold’s "Ortronics Systems" devices and Panduit Mini-Com connectors.
   4. Manufacturer:
      a. Panduit
         1) #CH02MEI-X; bezel adapter, 2 port, accepts Mini-Com connectors

2.6 LABELS

A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.

B. Labels for Horizontal Cables
   1. Adhesive backed labels and self-laminating feature.
2. Fit the horizontal cables listed above (i.e., shall fully wrap around the cable’s jacket).
3. Size: 2”x.05” printable area, minimum
4. Color: white
5. Manufacturer:
   a. Panduit
   1) #S100X150YAJ; labels for cable diameters 0.16”-0.32”, white, desktop printer
      (laser or ink jet)
   b. Or equal

2.7 MISCELLANEOUS COMPONENTS

A. Hook and Loop Cable Ties
   1. Width: .75”.
   2. Color: Hook and loop cable ties the same color as the cable to which it is being applied.
   3. Manufacturers:
      a. Panduit “Tak-Ty” series hook and loop cable ties
      b. Panduit
      1) #HLS-15R-0; black, 15’ roll, cut to length.
      c. Or Equal

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

A. Rooms: Prior to installation, verify equipment rooms are suitable to accept the horizontal cables and terminations.

B. Pathways: Prior to installation verify that pathways and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, “True Tape” the conduits).

C. Cable Integrity: Prior to installation, verify the cable’s integrity – both sheath and conductors. Documentation of pre-installation testing is not a close cut requirement, and is the responsibility of the Contractor.

3.3 INSTALLATION

A. Cable Installation and Routing
   1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.
   2. Place cables within designated pathways, such as conduit, cable tray, basketway, etc. Do not fasten (such as with hook and loop cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc), other systems (such as ceiling support wires, wall studs, etc), or to the outside of conduits, cable trays, or other non-approved pathway systems. Use of cable hangers for primary support of cabling requires approval by the Owner.
3. Place and suspend cables and conductors during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.

4. No cable length shall exceed 85 meters (279 ft) from the termination point in the TR to the termination point at the work area (permanent link).

5. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access.

6. Do not exceed manufacturer's limits for pulling tension.

7. Do not use cable-pulling compounds for indoor installations.

8. Maintain a minimum bend radius of 6 times the cable diameter during and after installation.

9. Route cables under building infrastructure (such as ducts, pipes, conduits, etc); Do not route cables over building infrastructure. The installation shall result in easy accessibility to the cables in the future.

10. Place cables 6", minimum, away from power sources to reduce interference from EMI.

11. Place a pull string along with cables where run in pathways and spare capacity in the pathway remains. Tie off ends of the pull string (to prevent the string from falling into the conduit).

12. Neatly dress and organize cables using designated cable routing facilities, and fasten to support devices via approved ties.

13. When exiting the primary pathway (cable tray) to the work area, exit via the top of the pathway. Secure the cables to the pathway using an approved hook and loop cable tie.

14. Provide 2-4 feet, minimum, sheathed cable slack — length not to exceed permanent link maximum length requirement. Place the slack within ceiling space neatly on a cable hanger.

15. Routing to Type "A8" Student Desk
   a. Route cables from primary pathway (cable tray) through conduit to outlet.
   b. Provide appropriate length patch cable to serve desk location as shown on drawings.

B. Cable Routing and Dressing within the TR
   1. Place cables within the overhead cable support and, when routing vertically, fasten the cables onto wall-mounted vertical cable support every 24 inches on-center using hook and loop cable ties.

   2. At the rack bay, route cables into the back of the vertical management sections (do not route cables into the front as this space is reserved for patch cords only). Divide the cables equally between both sides of an equipment rack such that a cable does not travel past the midpoint of the rack prior to termination. Dress and cut cables to length required to reach the designated termination point with no excess cable and slack left in the horizontal cable manager, vertical cable manager, and overhead cable support.

   3. Provide 15 feet of slack within the TR, minimum, sheathed cable slack — length not to exceed permanent link maximum length requirement. Place the slack in the overhead cable support.

C. Termination in the TR
   1. Provide termination apparatus and accessories required for a complete installation. Install and assemble termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.

   2. Properly strain relieve cables to and at termination points per manufacturer's instructions.

   3. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and ANSI/TIA-568-C.0 standard installation practices. Terminate cable pairs onto the termination apparatus. Terminate twisted pairs compliant to ANSI/TIA-568-C.0 and wired per 1.04 System Description.

   4. Modular Patch Panels and Horizontal Management Panels
a. Provide quantity of modular patch panels to support termination of cables served from respective TR. Provide quantity of horizontal management panels based on the quantity of patch panels.
b. Install and assemble modular patch panels and horizontal management panels according to the manufacturer's instructions.
c. Install the patch panels and the horizontal management panels as shown on the contract drawings. If configuration is not shown, install the patch panels in association with the horizontal management panels such that a management panel is mounted above and below given patch panel.

5. Termination Sequence
   a. Terminate voice and data cables on separate patch panels.
   b. Terminate the cables in sequential order using the link’s identifier starting at the top left and completing a panel before moving to the next panel below. Link identifier shall be based on the campus room numbers.

D. Termination at the Work Areas
   1. Provide device components, connectors, and accessories required for a complete installation. Install and assemble connectors, jacks, adapters, termination apparatus, accessories and associated management apparatus according to the manufacturer’s instructions.
   2. Provide six inches, minimum, sheathed cable slack behind each workstation outlet faceplate. Coil the slack cable inside the raceway, within the wall, or in the junction box (if used), per the cabling manufacturer’s installation standards.
   3. Type “A” Wall-Mount Faceplates
      a. Install devices at heights shown on the contract drawings.
      b. Mount faceplates plumb, square, and at the same level as adjacent device faceplates.
      c. Patch gaps around faceplates so that faceplate covers the entire opening.
      d. Surface mount outlets and conduit where walls are existing.
   4. Type “B” Wall-Mount Faceplates
      a. Coordinate installation of faceplate adapters with the architect and Owner.
      b. Mount outlets at +6” above table top.
      c. Surface mount outlets and conduit where walls are existing.
   5. Terminate cables and twisted pairs in accordance with manufacturer’s latest installation requirements and ANSI/TIA-568-C.0 standard installation practices. Terminate twisted pairs compliant to ANSI/TIA-568-C.0 and wired per 1.04 System Description.

E. Perform post-installation testing as described in the Telecommunication Testing specification (refer to Section 270811). Replace terminations and connectors not passing the required media test.

F. Patching and Crossconnecting
   1. Patch cords and crossconnects are Owner-provided.

3.4 LABELING

A. General Requirements
   1. Labeling, identifier assignment, and label colors shall conform to ANSI/TIA/EIA-606-A Administration Standard and as approved by the Owner or Owner’s Representative before installation.
   2. Permanent labels with machine-generated text (hand written labels will not be accepted).

B. Label Formats
   1. Horizontal Cable Labels
a. Text Attributes: Black, 1/8" high, minimum, or #12 font size.
b. Install labels on both ends of cables no more than 4" from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.

2. Patch Panel Labels
   a. Use modular patch panel labels included in the product packaging. Request approval by the Engineer for other labels.
   b. Use a label color for the respective field type, per TIA/EIA-606.
   c. Text Attributes: Black, 3/32" high, minimum, or #10 font size.

3. Termination Block Labels
   a. Use labels included in the product packaging. Any deviation from this requirement must be approved in writing by the Owner or Owner's Representative.
   b. Use a label color for the respective field type, per TIA/EIA-606-A.
   c. Text Attributes: Black, 3/32" high, minimum, or #10 font size.

4. Outlet Labels
   a. Use outlet labels included in the product packaging. Any deviation from this requirement must be approved in writing by the Owner or Owner's Representative.
   b. Label Background: White.
   c. Text Attributes: Black, 1/8" high, minimum, or #12 font size.
   d. Install label in the top label window. Leave the bottom label window blank.

C. Identifier Assignment
   1. General: Separate label fields of the identifier with a hyphen.
   2. Horizontal Cables
      a. First field: the originating room identifier (campus room number); for example: "241".
      b. Second field: the destination room number (campus room number); for example: "236".
      c. Third field: the outlet number within the destination room; for example: "1".
      d. Fourth field: the cable's intended service type followed by a unique sequential number; for example: "V1" (voice, cable #1) or "D2" (data, cable #2).
      e. Example: "241-236-1-V1"
   3. Outlets
      a. First field: the originating room identifier (campus room number); for example: "241".
      b. Second field: the destination room number (campus room number); for example: "236".
      c. Third field: the outlet number within the destination room; for example: "1".
      d. Example: "241-236-1"
   4. Individual Ports at the Outlets
      a. First field: the cable's intended service type followed by a unique sequential number; for example: "V1" (voice, cable #1) or "D2" (data, cable #2).
   5. Individual Ports at Patch Panels
      a. First field: the destination room number; for example: "236".
      b. Second field: the outlet number within the destination room; for example: "1"
      c. Third field: the cable's intended service type – for example: "D" (data), and a unique sequential number – for example: "2".
      d. Example: "236-1-D2"

3.5 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 270000.

B. Remove cables and replace with new those failing to meet the indicated standards and not passing the testing requirements of Section 270811 with no impact to cost and schedule. The Owner or Owner's Representative, will not accept the installation until testing has indicated a 100% availability of all cables and conductors. Any deviation from this requirement must be approved in writing by the Owner or Owner's Representative.
C. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION
SECTION 275313

COMMUNICATIONS CLOCK SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Communications wired clock/emergency notification system.

B. Related Divisions and Sections
   1. Comply with the Related Sections paragraph of Section 270000.
   2. 271513 Horizontal Twisted Pair Cabling
   3. Drawings, general provisions of the Agreement, and Division 01 apply to this Section.
   4. Consult other Divisions, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.

1.2 REFERENCES

A. Comply with the References requirements of Section 270000.

B. In addition to those codes, standards, etc., list in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
   1. IEEE 802.3af “Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)”

1.3 DEFINITIONS

A. Definitions as described in Section 270000 shall apply to this section.

B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:
   1. "LAN": Local Area Network
   2. "PoE": Power-over-Ethernet / IEEE 802.3af
   3. "NIST": National Institute of Standards and Technology (http://www.nist.gov/)
   4. "NTP": Network Time Protocol

1.4 SYSTEM DESCRIPTION

A. Work Covered Under Other Sections
   1. Cabling
   2. Conduit, device boxes, and sleeves
   3. Power
   4. Network equipment (PoE-enabled access switches)

B. Base Bid Work
   1. The Work of this Section includes materials, accessories, fasteners, etc., and the labor and associated services necessary for a complete working network-wired synchronized clock and emergency notification system, herein “System”, and includes coordination through the General Contractor with other trades.
   2. System Features:
      a. The System shall utilize the Owner's LAN.
b. The System shall be locally managed.
c. The System shall utilize the Owner's existing NTP service. The System will not require a dedicated synchronized time source and NTP server.
d. Clocks shall synchronize time to the network's NTP.
e. Clocks shall be powered via the network (implying PoE).

3. In general, the Work includes the following:
   a. Submittals
   b. Coordination with Owner's IT Department (specifically, DHCP support)
   c. Clocks/emergency notification two-way communication device
   d. Call button
   e. Wiring between clock/emergency notification two-way communication device and call button
   f. Identification tags and labeling
   g. Close out documents
   h. Warranty

1.5 SUBMITTALS

A. Comply with the Submittal requirements of Section 270000.

B. Quantity: Furnish quantities of each submittal as noted in Section 270000.

C. Submittal Requirements Prior To Construction:
   1. Product Data Submittal
   2. Integration Submittal:
      a. Proposed system diagram, including connection into Owner's LAN and connectivity requirements (physical requirements, network setting requirements, protocols, etc.)
      b. Integration with the Owner's network and servers – a diagram of network relationships
      c. Proposed sequence of Work
      d. Process flow chart
      e. Narrative of what the Integrator requires from the Owner
      f. Schedule of Work

D. Submittal Requirements at Close Out:
   1. As-Built Drawings
   2. Spreadsheet (electronic file in *.xls format) including the following information/columns:
      a. time display identifier
      b. telecommunications outlet (the time display is plugged into)
      c. floor
      d. telecommunications room (serving the time display)
   3. O&M Manual

E. Substitutions
   1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.

1.6 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING

27 53 13 - 2
Communications Clock System
A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

A. Warrant Work to perform as described within this Section for a period of 1 year. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 CLOCK / EMERGENCY NOTIFICATION DEVICE

A. Application: Suitable for an indoor environment, attached to an IP-based network.

B. UL 1950 / ETL listed

C. Clocks shall have a network interface compatible with 802.3 ‘Ethernet’, either half- or full-duplex, and shall be compatible with 802.3i 10BASE-T and/or 802.3u 100BASE-TX “Fast Ethernet”, including auto-negotiation.

D. Time displays shall be compatible with the following network protocols:
   1. SIP
   2. TCP/IP (IPv4/IPv6 dual stack)
   3. UDP
   4. DHCP – the clock shall be a DHCP client
   5. NTP
   6. IGMP
   7. ICMP
   8. MDNS and MDNS-SD
   9. SNMPV1 and SNMPV2c
   10. SLP
   11. TFTP

E. Clocks shall receive power via network as “Power-over-Ethernet” (PoE), and shall be compatible with 802.11af and 802.11at.

F. Clocks shall be compatible with Telnet for remote control of the display’s settings and options.

G. Clocks shall accommodate all Daylight Savings Time formats, with an enable/disable feature.

H. Clocks shall have an integrated speaker and microphone, with two-way communication, monitoring, and paging capabilities.

I. Clocks shall be capable of voice paging, bell scheduling, and alarms/notifications.

J. Clocks shall have built in flashers for emergencies and alerts.

K. Digital Display:
   1. Display height shall be 3 inches
   2. 4-digit time or 6-digit time (configurable)
   3. PM indicator (for 12-hour operation)
   4. Scrolling text with capability for 1 or 2 line display for custom text, alerts, etc.
5. Configurable fonts and colors
6. Auto dimming display
7. Mounting: wall, flush or surface mount

L. Manufacturers:
   1. Advanced Network Devices
      a. #IPSWD-RWB; IP speaker with digital display and flashers, flush mount
      b. #AND-BTN-KIT-1; two-way communication call button kit
      c. #IPS-FM1; IP speaker flush mount enclosure
      d. #IPS-SM1; IP speaker surface mount enclosure

PART 3 - EXECUTION

3.1 GENERAL

   A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

   A. Prior to installation, verify construction conditions are suitable for the Work of this Section. Schedule work to prevent damage caused by other trades during the course of that other construction.

   B. Prior to installation, verify the network cabling is complete and suitable for installation of the time displays, including patching in the telecommunications rooms.

   C. Prepare surfaces, such as walls, for installation of time displays.

   D. Coordinate installation with Owner or Owner's network integrator for DHCP and network settings.

3.3 INSTALLATION

   A. Clocks
      1. Install clocks and accessories according to manufacturer's instructions. Use the manufacturer's specific enclosure/box to mount the clock. Provide the flush-mount version of the enclosure/box for new walls and the surface-mount version of the enclosure/box for existing walls.

3.4 LABELING

   A. General Requirements: Labeling and identifier assignment shall conform to TIA/EIA-606-A Administration Standard and as approved by Owner before installation. Final label format will be provided by the Owner.

3.5 ADJUSTING, CLEANING, AND PROTECTING

   A. Adjust time displays to meet accuracy requirements.

   B. Clean displays' exposed surfaces using cleaning methods recommended by the manufacturer.
C. Remove temporary labels from displays. Do not remove manufacturer labels from displays.

D. Protect finished installation until punch walk and final acceptance.

3.6 FINAL INSPECTION AND CERTIFICATION

A. Prior to the scheduled punch walk, test System under normal conditions to assure operation according to the requirements of this Section.

B. Punch the Work of this Section compliant to the requirements of Section 270000.

C. Comply with system acceptance and certification requirements of Section 270000.

3.7 TRAINING

A. Provide two hours of training to Owner's representative. Training shall cover, at a minimum, setting and adjusting time displays, and routine maintenance.

END OF SECTION
SECTION 28 00 00

BASIC SECURITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes general administrative and procedural requirements for sections numbering 28xxxx and is intended to supplement, not supersede, the requirements specified in Division 1.

B. The requirements described herein include the following:
   1. References
   2. Definitions
   3. System Description and Existing Conditions
   4. Submittals
   5. Quality Assurance
   6. Permits and Inspections
   7. Coordination
   8. Project Management and Coordination Services
   9. Product Delivery, Storage, and Handling
   10. Warranty
   11. Maintenance

C. Products Supplied But Not Installed Under This Section:
   1. None

D. Products Installed But Not Supplied Under This Section:
   1. None

E. Products Specified But Not Installed Under This Section:
   1. None

F. Products Furnished and Installed Under another Section:
   1. 120V power
   2. Conduit, junction boxes, device boxes (essentially rough-in)
   3. Door hardware
   4. Network cabling and equipment

G. Related Sections:
   1. Consult other Sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation.
   2. Section 28 05 33, "Raceway and Boxes for Electrical Systems"
   3. Section 28 05 13, "Security System Cabling"
   4. Section 28 05 53, "Security System Labeling"
   5. Section 28 08 00, "Security System Acceptance Testing"
   6. Section 28 13 00, "Access Control and Alarm Monitoring System"
   7. Section 28 23 00, "Video Surveillance System"
   8. Section 28 16 00, "Intrusion Detection System"
9. Selective Demolition: Nondestructive removal of materials and equipment for reuse or salvage as indicated. Also dismantling electrical materials and equipment made obsolete by these installations.

10. Concrete Work: Include forming, steel bar reinforcing, cast-in-place concrete, finishing and grouting as required for underground conduit encasement, pedestal foundations, and curbs. [Also includes saw-cutting of existing slabs and grouting of conduits in saw-cut.]

11. Miscellaneous Metal Work: Include fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, equipment enclosures, cameras, and similar devices.

12. Miscellaneous Lumber and Framing Work: Include wood grounds, nails, blocking, fasteners, and anchorage for support of security materials and equipment. Refer to Division 6, Rough Carpentry.

13. Moisture Protection and Smoke Barrier Penetrations: Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors, ceilings, slabs and foundation walls. Tape and make vapor tight penetrations through vapor barriers at slabs on grade.

14. Division 8 Locking Hardware: Include interface to electronic hardware and door controllers on security related doors.

15. Access Panels and Doors: Required in walls, ceilings, and floors to provide access to security devices and equipment.

16. Painting: Include surface preparation, priming and finish coating as required for security cabinets, exposed conduit, pull and junction boxes, and devices where indicated as field painted in this Division.

1.2 REFERENCES

A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies mean that latest edition of such publications adopted and published prior to submittal of the bid. Consider such codes or standards a part of this Specification as though fully repeated herein.

B. Codes: Perform Work executed under this Section in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:

1. California Code of Regulations (CCR):
   a. Title 8, "Industrial Relations"
      1) Chapter 3.22, "California Occupational Safety and Health Regulations (CAL/OSHA)"
   b. Title 24, "California Building Standards Code"
      1) Part 1, "California Building Standards Administrative Code"
      2) Part 2, Volumes 1 and 2, "California Building Code" (CBC)
      3) Part 3, "California Electrical Code" (CEC)
      4) Part 11, "California Green Building Standards Code" (CALGreen)

2. National Fire Protection Agency (NFPA)
   a. NFPA 70, "National Electrical Code" (NEC)
   b. NFPA 75, "Protection Of Information Technology Equipment"

3. United States Department of Labor (DOL) Occupational Safety and Health Administration (OSHA) Regulations (Standards - 29 CFR)
   a. Part 1910, "Occupational Safety and Health Standards"
   b. Part 1926, "Safety and Health Regulations for Construction"
   b. Part 27, “Miscellaneous Wireless Communications Services”
   c. Part 68, “Connection of Terminal Equipment to the Telephone Network”
5. Other applicable national, state, and local binding building and fire codes

C. Standards: Perform Work and furnish materials and equipment in accordance with the latest editions of the following standards as applicable:
   1. Underwriter’s Laboratories (UL): Applicable listing and ratings.
      a. UL 294, “Access Control System Units”
      b. UL 1076, “Proprietary Burglar Alarm Units and Systems”
      c. UL 2044, “Commercial Closed-Circuit Television Equipment”

1.3 DEFINITIONS

A. The Definitions of Division 1 apply to the sections of Division 28.

B. In addition to those Definitions of Division 1, the following list of terms as used in this specification defined as follows:
   1. “ACAMS”: Access Control & Alarm Monitoring System
   2. “As directed”: As directed or instructed by Owner, or their authorized representative
   3. “Cabling”: A combination of cables, wire, cords, and connecting hardware [e.g., cables, conductor terminations, connectors, outlets, patch panels, blocks, and labeling]
   4. “Connect”: To install required patch cords, equipment cords, cross connect wire, etc. to complete an electrical or optical circuit
   5. “Engineer”: TEECOM
   6. “Furnish”: To purchase, procure, acquire, and deliver complete with related accessories
   7. “IDS”: intrusion detection system
   8. “Install”: To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to Owner, parts, items, or equipment supplied by Contractor or others. Complete installation and make ready for regular operation
   9. “Owner”: Contra Costa Community College District
   10. “Provide”: furnish and install
   11. "Security System": the ACAMS, IDS, VSS, and Intercom systems collectively and integrated
   13. “VAC”: volts alternating current
   14. “VDC”: volts direct current
   15. “VSS”: video surveillance system
   16. “VMS”: visitor management system

1.4 SYSTEM DESCRIPTION

A. Overview
   1. The Contra Costa Community College District is renovating offices and classrooms on Level 2 of the College Complex building located at Los Medanos College.
   2. Security at the new facility consists of access control and alarm monitoring (ACAMS), and intrusion detection (IDS). The ACAMS will automate opening and closing of the classrooms and computer labs, control access, and restrict after-hours access to authorized cardholders.
   3. The IDS will monitor spaces for intrusion and notify a 24/7 third-party monitoring station utilizes by the college/district. The third-party monitoring station will notify campus police for designated alarm events.
4. The new system will connect to Owner’s exiting head end located at the District Office over the Owner’s LAN/WAN.
5. The System includes integration to the Fire/Life Safety system to disconnect power to magnetic door holders and automatically close doors after hours.
6. Refer to individual sections for detailed description of systems.

B. Custom Device Requirements
   1. General: Provide a high level of coordination services to ensure the proper installation and functioning of the security system. Coordinate the installation of the security system with other trades. This may include: review of other trade's shop drawings, attendance at meetings, providing samples for mockup, and preparation & distribution of written documentation.

1.5 SUBMITTALS

A. Submit required submittals in accordance with the requirements of section 01 33 00 "Submittal Procedures".

B. Required submittals include the following:
   1. Written detailed project description
   2. Project schedule as referenced in this section
   3. Product data sheets – clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories which are included and those which are excluded
   4. Estimated delivery lead times for products
   5. Voltage drop calculations demonstrating less than ten percent voltage loss to individual security devices
   6. Battery calculations showing backup support of security equipment and locks (except egress hardware with local power supplies) for 4 hours, minimum.

C. Complete submittals are comprised of shop drawings and product data sheets as detailed below and related sections (covering specific security systems). Incomplete or partial submittals will be rejected.

D. Shop Drawings
   1. Shop drawings shall document Contractor’s intent to execute the work and shall include the following:
      a. Title sheet and index
      b. Floor plans showing device locations, cable routing, and pathways
      c. System block diagrams
      d. Point-to-point wiring diagrams
      e. Specific wiring details and device mounting/installation details
      f. Schedules:
         1) Building/floor
         2) Unique device name/number
         3) Security controller/location
         4) Interfaces, interlocks
         5) IP address
   2. Upon award of contract, request CAD release forms from TEECOM so that electronic files may be released for Contractor’s use. TEECOM will release floor plans with devices; TEECOM will not installation details and block diagrams (Contractor shall develop their own diagrams and details for the shop drawings submittal package).
E. Format: Furnish submittal data in electronic copy including table of contents with each section bookmarked by specification section listing materials.

F. Label each submittal with the specification section number and provide a cover letter or stamp stating that the submittal has been thoroughly reviewed by Contractor and complies with the requirements of the contract documents. Failure to comply with this requirement will constitute grounds for rejection of the submittal.

G. Resubmittals: Provide a cover letter with the resubmittal that lists the action taken and revisions made to each product submittal in response to submittal review comments. Failure to include this cover letter will constitute rejection of the resubmittal package and no review will occur.

H. Drawings
   1. Prepare shop and as-built drawings using software compatible with AutoCAD and/or Revit per project standard.
   2. Drawing requirements:
      a. Sheet size: match the project’s contract drawings size and use the project’s title block
      b. Text size: minimum 3/32 inches high when plotted at full size
      c. Symbology: match the project’s contract drawings symbols
      d. Backgrounds: screen background information to allow pertinent drawing information to stand out.
      e. Line Weights: Use appropriate line weights for devices, raceways, and text to stand out against background information.
      f. Floor Plans: 1/8 inch scale floor and site plans showing the locations of devices and cable routing paths with cable types and quantity called out.

I. Contractor Qualifications: Submit the following for review and comment at the beginning of the project.
   1. Resumes of the project manager, general foreman, and lead technician(s) indicating role, years of experience, product certifications and training, listing of similar projects the individual performed the role proposed for this project along with client contact information for each.
   2. Certification letters from manufacturers of major system components stating Contractor is an authorized reseller, installer, and extended warranty provider for the specified security systems.

J. Samples
   1. Submit samples as required for proper coordination and installation of custom mounted equipment. Examples of samples that may be required include:
      a. Screen shots showing graphical floor plan maps indicating:
         1) Active functional icons
         2) Secure areas/zones

1.6 QUALITY ASSURANCE

A. General
   1. Provide new and unused materials, equipment, and parts comprising the units specified herein of current manufacturer and of highest grade.
   2. Only use products and applications listed in this Division on the project.

B. Bid Discrepancies
1. In the event of discrepancies within the contract documents, notify Engineer within 5 days prior to the bid opening to allow the issuance of an addendum.

2. If, in the event that time does not permit notification or clarification of discrepancies prior to the bid opening, the following applies: The drawings govern in matters of quantity, and the specifications govern in matters of quality. In the event of conflict within the drawings involving quantities, or within the specifications involving quantities, or within the specifications involving quality, the greater quantity and higher quality apply. Note such discrepancies and clarify in the bid. We will make no additional allowances because of errors, ambiguities, or omissions, which reasonably should have been discovered during the preparation of the bid.

C. Substitutions
1. Conform to the general requirements and procedure outlined in section 012500 "Substitution Procedures".
2. Where products are noted as "or equal", a product of equivalent design, construction, and performance is considered. Include in the product data submittal: catalog cuts, product information, and pertinent test data required to substantiate that the product is in fact equivalent to that specified.
3. Only one substitution allowed for each product specified. Do not provide substituted material, processes, or equipment without written authorization from Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by Engineer, are at the sole risk of Contractor.
4. The burden of proof rest with Contractor that the substituted product is equivalent or better than the specified product. When Engineer accepts a substitution in writing, it is with the understanding that Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Approved substitutions do not relieve Contractor of responsibilities for the proper execution of the Work, or from provisions of the Specifications.
5. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the contract documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when "or equal" follows the manufacturers' names or model number(s).
6. Whenever material, process or equipment is specified in accordance with a Federal specification, an ASTM standard, an ANSI specification, UL rating or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by Engineer, submit support test data to substantiate compliance at no additional cost.
7. Pay expenses, without additional charge to Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, Subcontractor's or other Contractor's work.

D. Electronic Control Systems Contractor Qualifications
1. A current, active, and valid and C7 or C10 license registered with the Contractors State License Board (CSLB)
2. Minimum five years of experience in installation and service of access control, video surveillance, and intrusion detection systems
3. Minimum five completed projects similar to scope and cost
4. Evidence of technicians qualified for the work in the form of current manufacturer's training certification

E. Materials
1. Provide new materials and equipment without defects.
2. Provide only specified products and equipment, or products and equipment that have been approved in writing.

F. Regulatory Requirements
1. Work and materials to conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Perform work under these specifications confirming to the most stringent of the applicable codes.
2. Provide the quality identified within these specifications and drawings when codes, standards, regulations, etc. allow work of lesser quality or extent. The contract documents address the minimum requirements for construction.

G. Drawings
1. Layout: Follow the general layout shown on the Drawings except where other work may conflict with the Drawings.
2. Accuracy: The Drawings show a diagrammatic representation of the system within the constraints of the symbology applied.
3. Detail: The drawings do not fully represent the entire installation for the Security System. Drawings indicate the layout and location of control console(s) components, as well as location of security devices, i.e. card readers, door locks and contacts, and duress stations. The drawings do not show conduits, wire and cabling between every system component, equipment, or device.
4. Complete the details necessary for point-to-point design. This allows Contractor to achieve desired results applying their own procedures and methods. Submit shop drawings for review prior to installation.

H. Role of Engineer
1. During the construction phase of the project, Engineer will work with Contractor to provide interpretation and clarification of project contract documents, process and reply to relevant Requests for Information (RFI), and act as an interface between Contractor and Owner.
2. Owner has retained Engineer’s services to observe the work for general compliance with the contract documents.
3. In summary, Engineer will perform the following specific services during the design phase:
   a. Review product submittals and shop drawings for general compliance with the contract drawings and specifications.
   b. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.
   c. Interpret field problems for Owner, and translate into understandable language.
   d. Review the testing procedures to confirm compliance with industry-accepted practices.

1.7 PERMITS AND INSPECTIONS

A. Obtain and pay for permits and inspections required for the work.

B. Furnish materials and workmanship for this work in conformance with applicable legal and code requirements.

C. Perform tests required herein, or as may be reasonably required to demonstrate conformance with the Specifications or with the requirements of legal authority having jurisdiction.
D. Obtain review from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with requirements of reference codes indicated herein.

1.8 PROJECT MANAGEMENT AND COORDINATION SERVICES

A. Provide a project manager for the duration of the project to coordinate the security system work with other trades. Coordination services, procedures and documentation responsibility include at a minimum, the items listed in this section.

B. Review of Shop Drawings prepared by Other Subcontractors:
   1. Obtain copies of shop drawings for equipment and systems provided by others that require connections or interface with the security system work. Thoroughly review those shop drawings to confirm compliance with the interface requirements.
   2. Document discrepancies or deviations:
      a. Prepare memo summarizing the discrepancy.
      b. Submit a copy of the specific shop drawing, indicating via cloud, the discrepancy.
   3. Prepare and maintain a shop drawing review log indicating the following information:
      a. Shop drawing number and brief description of the system/material.
      b. Date of your review.
      c. Indication if follow-up coordination is required.

C. Scheduling: Prepare work schedules for each floor indicating the following information:
   1. Submittals
   2. Cable Installation
   3. SEC Build Out
   4. Device Installation
   5. Programming
   6. Testing
   7. Training
   8. Other tasks included under the alternate work section of these specifications

D. Job Conditions
   1. Protection: Keep conduits, junction boxes, outlet boxes and other openings closed to prevent entry of foreign matter. Cover equipment, devices, and apparatus to protect them against dirt, paint, water, chemical or mechanical damage, before and during construction period. Prior to final acceptance, restore to original condition fixture, apparatus or equipment damaged including restoration of damaged factory applied painted finishes. Protect bright finished surfaces and similar items until in service. No rust or damage will be permitted.
   2. Supervision: Personally, or through an authorized and competent representative, supervise the work from beginning to completion and, within reason, keep the same foreman and workmen on the project throughout the project duration.

E. Weekly Status Reports: Prepare weekly status reports throughout the entire course of the project containing the following information:
   1. Current / up-to-date 2-week look ahead schedule
   2. Progress during prior week
   3. Work expected to be completed during the upcoming week
   4. Delivery dates for equipment
   5. Coordination status for each device requiring coordination with other subcontractors
   6. Summary of the information owed to Contractor, who is responsible for providing the information, and due date for the information
F. Weekly Meetings: Conduct or attend weekly coordination meetings with the electrical and other specialty subcontractors to coordinate the installation of the security systems.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery
   1. Do not deliver security system components to the site until protected storage space is available.
   2. Replace equipment damaged during shipping and return to manufacturer at no cost to Owner.

B. Storage
   1. Store materials in a clean, dry, ventilated space free from temperature extremes. Storage outdoors covered by rainproof material (for example, a tarp) is not acceptable.
   2. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.
   3. Provide heat where required to prevent condensation or temperature related damage.

C. Handling
   1. Handle in accordance with manufacturer's written instructions.
   2. Prevent internal component damage, breakage, denting and scoring. Do not install damaged equipment. Replace damaged equipment and return equipment to manufacturer.

1.10 WARRANTY

A. Provide the Security System as described in this specification with one-year parts and service warranty at no additional cost to Owner.

B. Include in the warranty package, at a minimum, the following:
   1. Emergency maintenance service on regular working hour basis
   2. Service by factory trained and employed service representatives of system manufacturer

C. Maintain regular service facilities and provide a qualified technician familiar with this work at the site within four hours of receipt of a notice of malfunction including weekends and holidays. Provide material, devices equipment and personnel necessary for repairs. Install approved temporary, alternate equipment if required by Owner, complete and operational within 24 hours after notification of a malfunction, at no additional cost.

D. Conduct warranty repairs and service at the job site unless in violation of manufacturer's warranty; in the latter event, provide substitute systems, equipment and/or devices, acceptable to Owner, for the duration of such off-site repairs. Transport warranty substitute and/or test systems, equipment, devices, material, parts and personnel to and from the job site at no additional cost.

E. Warranty period shall commence upon written final acceptance by Owner or Owner's designated representative.

1.11 MAINTENANCE

A. Extra Materials
   1. Deliver extra materials to a secured location determined by Owner.
2. Provide a complete bill of materials listing quantities, part numbers, and descriptions for each device for Owner to sign indicating receipt of equipment.
3. Provide new and unused spare parts in their original packing materials upon delivery.

B. Maintenance Service
1. For the first year of service, conduct quarterly system performance review meetings to review system operation problems and/or defects that occurred during the preceding 3 months. During these performance review meetings, perform the following:
   a. Visual checks and operational tests of the central processor, local processors, monitors, keyboards, system printers, peripheral equipment, security equipment and devices, power supplies, and electrical and mechanical controls.
   b. Clean system equipment, including interior and exterior surfaces.
   c. Perform diagnostics on equipment.
   d. Check and calibrate each device.
   e. Run system software and correct diagnosed problems.
   f. Resolve previous outstanding problems.
2. Provide software and firmware updates issued free of charge by the manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

A. Material and equipment specified herein have been selected as the basis of acceptable quality and performance and have been coordinated to function as components of the included systems. Where a particular material, device, equipment or system is specified directly, the current manufacturer’s specification for same is a part of these specifications, as if completely elaborated herein.

B. Use standard, regularly manufactured, materials and equipment for this and/or other similar systems, and not custom designed especially for this project. Provide systems and components thoroughly tested and proven in actual use. Provide subsystems of one manufacturer.

2.2 EQUIPMENT ENCLOSURES AND JUNCTION ENCLOSURES

A. Application: For indoor use to house panels and equipment, and to house terminations, relays, and other components local to controlled doors and other field devices

B. Type: NEMA type 1 enclosure

C. Description:
   1. Solid steel enclosure with solid, continuous-hinged door
   2. Finish: ANSI 61 gray polyester powder paint finish inside and out
   3. Lockable / equipped with a lock kit (lock kits shall be keyed alike with other security enclosures throughout the project)
   4. Perforated back panel within enclosure (for mounting control boards, relays, terminal strips, etc.)
   5. One tamper switch per enclosure
   6. One 5" electric fan with a screen at the port per enclosure that houses electrically-powered devices/equipment

D. Size:
   1. For use as Security Equipment Enclosure: 36"L x 24"W x 6"D minimum
2. For use as Security Junction Enclosure: 12"L x 12"W x 6"D minimum

E. Manufacturer, or equal:
   1. Eaton Cooper B-Line
      a. #36246-1PP; 36"L x 24"W x 6"D enclosure with back panel and lock kit
      b. #12126-1PP; 12"L x 12"W x 6"D enclosure with back panel and lock kit
   2. Hoffman
      a. #A36N24M; 36"L x 24"W x 6"D enclosure
      b. #A36N24MPP back panel for 36" x 24" enclosure
      c. #A12N126; 12"L x 12"W x 6"D enclosure
      d. #A12N12PP; back panel for 12" x 12" enclosure
      e. # A612AR; lock kit

2.3 SLOTTED WIRING DUCT

A. For indoor use inside equipment enclosures to manage/mind wiring.

B. Description:
   1. Type: Lead-free PVC with narrow finger design
   2. Color: Light gray

C. Manufacturer, or equal:
   1. Panduit Type-F narrow slot wiring duct
   2. Iboco #T1-1010 wiring duct

2.4 WIREWAYS

A. For indoor use with equipment enclosures to manage and route wiring and cabling.

B. Type: NEMA type 1 screw cover 'gutter' wireway and accessories

C. Description:
   1. Wireways shall have open top assembly and closure plates/end caps (to secure end of wireway sections).
   2. Finish: ANSI 61 gray polyester powder paint finish inside and out
   3. Size: 4" x 4", minimum

D. Manufacturer, or equal:
   1. Eaton Cooper B-Line #4448-G-NK; lay-in painted wireway without knockouts
   2. Hoffman #F44T148GVP lay-in painted wireway without knockouts

2.5 INTERFACE RELAYS

A. Application: lock power switching and interfacing with other high-voltage powered equipment, i.e. gates, high-voltage locks, etc. (not for use at the output contacts on the access controllers since their rating is not adequate)

B. Type: Standard industry control, plug-in type with LED indicator lights to indicate when the relay is energized.
C. Contacts: Rated for 10 amps at 120VAC.

D. Coil Operating Voltage: as required, with 24VDC as first choice

E. Features:
   1. Color-coded test button
   2. Mechanical flag
   3. Snap-on label
   4. Pilot light
   5. 2mm test jacks
   6. Dual contact markings
   7. Snap-on number and letter markers
   8. Solid bus-bar socket construction

F. Relay bases shall be mountable on standard mounting rails

G. Manufacturer, or equal:
   1. Turck #Releco
   2. Idec

2.6 TAMPER RESISTANT HARDWARE

A. Tamperproof hardware shall be used in locations below 10' exposed to the public.

B. Hardware exposed in public spaces shall be pinned-allen type.

C. Hardware used in specialty metal surfaces shall have a similar finish color.

2.7 WIRE CONNECTORS

A. Wire connectors shall be heat activated, gel filled.

B. Twist and solder/taped or wire nut connections are not acceptable.

C. Manufacturer, or equal:
   1. Dolphin
   2. 3M Terminals
   3. Fastenal Sealed Crimp and Solder connector

PART 3 - EXECUTION

3.1 EXAMINATION

A. Conditions: Verify existing conditions, which have been previously provided under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

B. Pathways: Verify that pathways and supporting devices, which have been previously provided under other sections, are properly installed, and that temporary supports and devices have been removed.
C. Field Measurements: Verify dimensions of pathways, including length of pathways. For example, "True Tape" the conduits to verify cable distances.

3.2 FIELD QUALITY CONTROL

A. Staffing: Provide a qualified foreman who is in charge of the work and who is present at the job site at times work is being performed. Perform the work using skilled technicians under the direction of the foreman. Supervise the work force executing the work. Perform the installation within the restraints of the construction schedule. Do not change the supervisor during the project without prior written approval from Owner.

B. Inspection: Perform inspection after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion, and inspection as required.

3.3 INSTALLATION

A. Perform this work in accordance with acknowledged industry and professional standards and practices and the procedures specified herein.

B. Provide a complete, operating system. Include devices specified including basic components and accessories, interconnecting wiring and other equipment and installation devices necessary for a complete system as specified.

C. System Password Management:
   1. Change default passwords.
   2. Create a base administrator account for Owner's use/login.
   3. Install the latest security patches (for the operating system and each individual piece of equipment).
   4. Disable unused communication ports or protocols.
   5. Perform quarterly software security patch updates for the client during the warranty period.
   6. Contractor to turn over all source media including installation discs, manuals, drives, dongles, and licensing keys and codes.

D. Manufacturer's Instructions:
   1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
   2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite.

E. Boxes, Panels, and Enclosures
   1. Install boxes, panels, and enclosures square and plumb.
   2. Set flush-mounted units with the face of the cover, bezel, or escutcheon in the same plane as the surrounding finished surface.
   3. Mount boxes, panels, and trim so that there are no gaps, cracks, or obvious lines between the trim and the adjacent finished surface; ready them to receive final finish, as applicable.
   4. Install insulating terminations in signal circuit boxes, panels, wireways, or enclosures.

F. Painting
   1. Custom paint devices as indicated on the drawings.
3.4 REPAIR/RESTORATION

A. Replace or repair work completed by others that you deface or destroy, and at no cost to Owner.

B. Punch List:
   1. Inspect installed work and develop a punch list for items needing correction.
   2. Submit punch list to Engineer for review prior to performing punch walk with Engineer.

C. Re-Installation:
   1. Make changes to the system such that defects in workmanship are correct and cables and the associated termination hardware passes the minimum test requirements.
   2. Repair defects prior to system acceptance.

D. Painting: Repaint surfaces altered during installation of the security system to match previous conditions.

3.5 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials. Remove installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.

C. Repair or replace damaged installed products.

D. Legally dispose of debris in an environmentally friendly manner.

E. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

END OF SECTION
SECTION 28 05 13
SECURITY SYSTEM CABLEING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Cables and wires for security systems

B. Related Sections:
   1. Consult other sections; determine the extent and character of related work and properly coordinate work executed under this section with that specified elsewhere to produce a complete and operable system.
   2. Section 28 00 00, "Basic Security Requirements"
   3. Section 28 05 53, "Security System Labeling"
   4. Section 26 05 33, "Raceway and Boxes for Electrical Systems"
   5. Section 27 15 13, "Communications Horizontal Twisted Pair Cabling"

1.2 REFERENCES

A. Comply with the References requirements of section 28 00 00.

B. In addition to those codes, standards, etc., listed in section 280000, products and work shall comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
   1. NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces"
   2. ANSI/UL 1666, "Test for Flame Propagation Height of Electrical and Optical-Fiber Cable Installed Vertically in Shafts"
   3. UL 2196, "Standard for Tests of Fire Resistive Cables"

1.3 SUBMITTALS

A. Submittal Requirements at Start of Construction:
   1. Product Data: Submit product information, including manufacturer, part number, description, use/application, jacket rating, outside diameter, etc.

B. Submittal Requirements at Closeout:
   1. Include wire and cable types in As-Built Drawings
   2. Include wire and cable information in O&M Manuals

1.4 SCOPE OF WORK

A. General: Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation as described in these specifications.

B. Cables for Security System
   1. Provide wires and cables sized to allow for voltage drop of 12VDC and 24VDC power service from power supplies in equipment rooms to field devices.
2. Provide cables effectively shielded for video signal cable within the same conduit to mitigate interference or signal noise.
3. Provide plenum rated jacket (type CL2P, CL3P, or CMP) on cables installed indoors where required.
4. Provide PVC or PE jacket, flooded cables to prevent water intrusion where installed outdoors, underground, and/or within slab-on-grade. Provide transition of outdoor/underground cables to indoor cables when entering a building.
5. Provide surge protection when cables enter buildings from outdoors where required by CEC.

C. Cable Supports and Pathways for Security System Cabling
   1. Provide dedicated cable support for security cables when not within primary pathways (such as cable tray). Coordinate work with Division 27 – particularly for use of pathways/cable support.

PART 2 - PRODUCTS

2.1 INDOOR PLENUM MULTI-CONDUCTOR CABLES

A. Application: Indoor use, for ACAMS and IDS

B. Type: multi-conductor or paired, unshielded and shielded

C. CMP (plenum) rated

D. Manufacturers, or equal:
   1. Belden
      a. #6500UE; 22AWG/2C, unshielded
      b. #6502UE; 22AWG/4C, unshielded
      c. #1325A; 22AWG/2PR, individually shielded
      d. #6502FE; 22AWG/4C, overall shielded
      e. #6504FE; 22AWG/6C overall shielded
      f. #3004A; 22AWG/6C overall shielded
      g. #8300UE; 18AWG/2C, unshielded
      h. #8302UE; 18AWG/4C, unshielded
      i. #8302FE; 18AWG/4C, overall shielded
      j. #6100UE; 14AWG/2C, unshielded
   2. West Penn
      a. #25221B; 22AWG/2C, unshielded
      b. #25241B; 22AWG/4C, unshielded
      c. #D25510B; 22AWG/2PR, individually shielded
      d. #253241B; 22AWG/4C, overall shielded
      e. #253270B; 22AWG/6C overall shielded
      f. #253271B; 22AWG/6C overall shielded
      g. #25224B; 18AWG/2C, unshielded
      h. #25244B; 18AWG/4C, unshielded
      i. #253244B; 18AWG/4C, overall shielded
      j. #25226B; 14AWG/2C, unshielded
   3. Windy City Wire
      a. 444362; 22AWG/2C, unshielded
      b. 444381; 22AWG/4C, unshielded
      c. 4150102; 22AWG/2PR, individually shielded
      d. 4443440; 22AWG/4C, overall shielded
      e. 444351-03; 22AWG/6C overall shielded
f. 444352-08; 22AWG/8C overall shielded

g. 442363; 18AWG/2C, unshielded

h. 442384; 18AWG/4C, unshielded

i. 442344; 18AWG/4C, overall shielded

j. 447960; #6100UE; 14AWG/2C, unshielded

2.2 IP CAMERA CABLE

A. Application: Suitable for indoor installation within conduit

1. Refer to Section 27 151 3 for product requirements.

2.3 MISCELLANEOUS COMPONENTS

A. Cable Ties

1. Width: 0.75 inches

2. Color: Black

3. Manufacturers, or equal:
   a. Panduit HLS-15-R-0 Black, 15 feet roll, cut to length

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cable Installation and Routing

1. Install cables and wires continuously (splices will not be permitted without written approval from the Engineer) for the entire length of run between connections and/or terminations.

2. Place and suspend cables within designated pathways, such as cable hangers, cable tray, etc. Do not fasten or attach cables (such as with cable ties) to other building infrastructure (such as ducts, pipes, conduits, etc.), other systems (such as ceiling support wires, wall studs, etc.), or to the outside of conduits, cable trays, or other non-approved pathway systems.

3. Place and suspend cables during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.

4. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access.

5. Route cables under building infrastructure (such as ducts, pipes, conduits, etc.) so the installation results in easy accessibility to the cables in the future.

6. Do not exceed manufacturer's limits for pulling tension.

7. Do not use cable-pulling compounds for indoor installations.

8. Dress and secure cables without stress and/or deformation. Dress and bind cabling with cable ties every 24" minimum. Within telecommunications spaces and covered wireways, provide Velco-style cable ties on security cabling.

9. Install shielded wiring or route in separate raceways as recommended by the manufacturer's current requirements.

10. Place cables a minimum of 6" away from power sources to reduce interference from EMI.

11. Do not run signal wire and cable in parallel to power (120VAC).

12. When connecting to screw-type barrier blocks, terminate wires with insulated crimp-type spade lugs. Size lugs properly to assure high electrical integrity, i.e., low resistance connections.

13. Follow manufacturers recommended guidelines for installation.
14. When exiting the primary pathway (such as cable tray) to the device, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.

15. When routing cables vertically in conduit for continuous distances greater than 30 feet, secure cables as the cables exit the vertical pathways. Secure cables using screw-flange nylon cable ties or similar approved ties. Provide symmetrical clamping devices with split, circular, or other wire conforming, nonmetallic bushings for coaxial cables.

16. Within telecom rooms, route and dress cables on the overhead cable support and, when routing vertically, fasten the cables onto wall-mounted vertical cable support every 24 inches on-center using cable ties.

B. Cable Support

1. Above ceilings, support cables at intervals no greater than 5 feet.
2. Anchor cable support system/components to structure.
3. Vertical Support on floor space, not in riser system
   a. Route cable from below suspended ceiling devices to above ceiling when possible.
   b. When routing cable in fire-rated wall assemblies, provide conduit and firestopping.
   c. When routing cable on concrete tilt up style walls from below ceiling devices to above ceiling, provide conduit – either surface or recessed (depending on wall construction).
   d. For cable routed vertically from devices with no suspended ceiling, provide conduit stub from device junction box to 14 feet, minimum, above finish floor.
4. Label cables in accordance with section 28 05 53, "Security System Labeling".

END OF SECTION
SECTION 28 05 53
SECURITY SYSTEM LABELING

PART 1 - GENERAL

1.1 SUMMARY

A. General: Furnish labor, materials, tools, etc., as required to complete security system labeling.

B. Section Includes:
   1. Labeling of wire, cable, security devices, enclosures, and raceways.

C. Related Sections:
   1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 28 00 00, "Basic Security Requirements"

1.2 SUBMITTALS

A. Product Data: Submit the following:
   1. Product information for components specified herein.
   2. List of equipment (wire, cable, devices, enclosures, and raceways) and the corresponding text for the label.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Engraved, plastic laminated nameplates, signs, and instruction plates. Engrave stock melamine plastic laminate 1/16 inch minimum thickness for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Use white letters for engraved nameplates and punch for mechanical fasteners.

2.2 WIRE AND CABLE LABELS

A. General
   1. Self-laminating adhesive laser labels.
   3. Cable size: 0.16 – 0.32" OD
   4. Color: white with black lettering

B. Manufacturer, or equal:
   1. Brady #WML-211-295 and #WML-311-292 wire marking labels

2.3 DEVICE LABELS

A. Self-laminating, type on tape, adhesive labels. Use Helvetica 12 pt text

PART 3 - EXECUTION
3.1 INSTALLATION

A. General Requirements
   1. Label the security system components. The components include, but are not limited to, the following:
      a. Equipment Enclosures
      b. Conduits
      c. Security Devices
      d. Batteries
      e. Wires and Cables
      f. Equipment Racks
      g. Terminal Blocks
      h. Relays
      i. Patch panels, and the termination positions within the patch panels.
   2. Labels shall coincide with device IDs used on the record drawings.
   3. Degrease and clean surfaces to receive nameplates and labels.
   4. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using machine screws.

B. Equipment Cabinets
   1. Label SEC enclosures associated with the security system with a nameplate.
   2. Mount label on exterior of door, centered horizontally, and positioned one-third of the door height vertically from the top.
   3. Example: Line 1 [1/2 inch high letters]: "SEC-01"
      Line 2 [1/4 inch high letters]: "Security Equipment Cabinet"

C. Conduits
   1. Write the destination for every conduit entering a junction box, SEC, and CEC enclosure, or wireway using a black permanent ink marker next to the conduit inside the box.
   2. Example: "To SEC-01"

D. Security Devices
   1. Label devices associated with the security system with a permanent machine generated, laminated, label. Use 12 point Helvetica text with a clear background. Use white or black lettering depending upon the color of the device.
   2. Label each device in a concealed location with the system point number and address.

E. Batteries
   1. Label power supply batteries with the month and year they were installed.
   2. Example: "April 2016"

F. Wire and Cable
   1. Identify wire and cable clearly with permanent machine-generated labels wrapped about the full circumference within 1 inch of each connection.
   2. Indicate the cable ID designated on the associated field or shop drawings or run sheet, as applies.
   3. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable to carry the same labeled designation over its entire run, regardless of intermediate terminations.
   4. Provide labels where wire and cable first enter and exit from conduit, junction or distribution boxes; locate labels within 6 inches of the point of exit.
   5. Positional labels so they are clearly visible without the need to remove wire management or other obstructions.
6. Label cables at both ends of a run and within pull and junction boxes using machine generated wrap-around labels.

3.2 CABLE LABEL FORMAT

A. Text: Helvetica font, 12 point (minimum size, unless otherwise specifically stated)

B. From Panel to Field Device
   1. Line 1: Device Type and Device Number
   2. Line 2: Panel ID – Port Number
   3. Example: CR 001
      PANEL 2 – CR5

4. Standard Device Types
   a. CR = Card Reader
   b. R = Relay Output
   c. A = Alarm Point

5. Standard Port Numbers
   a. CR = Reader
   b. M = Monitored Input
   c. R = Relay Output

C. From Door Junction Box to Card Reader
   1. Line 1: Device Type and Device Number
   2. Line 2: Panel ID – Port Number
   3. Example: CR 001
      PANEL 4 – CR3

D. Miscellaneous Examples:
   1. From Door Junction Box to Door Contact
      a. CR001
      b. DC
   2. From Door Junction Box to Rex Alarm
      a. CR001
      b. REX ALM
   3. From Panel to Rex
      a. CR001
      b. REX PWR
      c. 12 VDC
   4. From Panel to Lock
      a. CR001
      b. LCK PWR
      c. 24 VDC

E. Communications Cable
   1. Line 1: Communication Type and Direction
   2. Line 2: Panel ID
   3. Example: RS-485 TO
      PANEL 2
   4. Typical Communication Types
      a. RS-485
      b. RS-232

END OF SECTION
SECTION 28 08 00
SECURITY SYSTEM ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, and transportation required to test a completed security system installation as described in these and the related Specifications.

B. Base Bid Work
1. Comprehensive testing for all systems installed as part of the project in two distinct phases which includes:
   a. Functional Testing
   b. Acceptance Testing
2. Produce and submit for review and approval the test results documentation for each of the two distinct phases of testing.

C. Related Sections:
1. Section 28 00 00, "Basic Security Requirements"
2. Section 28 05 13, "Security System Cabling"
3. Section 28 05 53, "Security System Labeling"
4. Section 28 13 00, "Access Control and Alarm Monitoring System"
5. Section 28 16 00, "Intrusion Detection System"

1.2 SUMMARY OF ACCEPTANCE TESTING ACTIVITIES

A. Overview
1. The purpose of these testing activities is to ensure the security system operates properly and per the Owner's requirements. Security systems are very complex from both an equipment and programming standpoint and thorough testing is necessary to ensure correct operation.
2. Perform testing activities after-hours or on weekends when the system is not being actively utilized and the building is generally unoccupied. This will minimize the amount of irrelevant activity in the system activity reports that will be used as a record of the Functional Testing and Acceptance Testing test results documentation.

B. Functional Testing
1. Functional Testing represents a complete and documented test of the security systems. At a minimum, Functional Testing shall demonstrate proper operation of security system components, including: devices, sensors, switches, power supplies, controllers, input/output boards, relays, network communications, tamper switches, initiating circuits, and associated accessories and appurtenances required for system functionality.
2. Perform Functional Testing of security systems to verify correct operation prior to scheduling the Acceptance Testing.
3. Document the results of the Functional Testing and submit to the Engineer along with system activity reports for approval.
4. Functional Testing test results documentation shall be reviewed and approved prior to scheduling the Acceptance Testing.

C. Acceptance Testing
1. Acceptance Testing represents a final walk test with the Engineer and Owner to demonstrate proper operation of security system components including system integration, programming, operational capabilities, and functional performance.

2. Perform Acceptance Testing of the security systems in the presence of the Engineer and Owner to demonstrate fully functional and completely operational security systems.

3. Submit Acceptance Testing test results documentation and punch list/deficiencies corrections, prior to Owner approval of Substantial Completion and the start of the Warranty period.

1.3 SUBMITTALS

A. Functional Testing test results documentation submittal

B. Acceptance Testing test results documentation submittal

C. Operation and Maintenance (O&M) Manuals: Submit O&M Manuals for review and approval at the completion of the project consisting of the following:
   1. Warranty letter: copy of Warranty letter reflecting start and end dates, and instructions covering warranty procedures.
   2. Functional Design Manual: includes a detailed explanation of the operation of the system.
   3. Hardware Manual, which includes:
      a. Pictorial parts list and part numbers
      b. Pictorial and schematic drawings of wiring systems including devices, control panels, instrumentation, and annunciators
      c. Telephone numbers for the authorized parts and service distributors
      d. Service bulletins
   4. Software Manual, which includes:
      a. Use of system and applications software
      b. Initialization, start-up, and shut down procedures
      c. Alarm reports
   5. Operator’s Manual, which fully explains procedures and instructions for the operation of the system and includes:
      a. Computers and peripherals
      b. System start up and shut down procedures
      c. Use of system, command, and applications software
      d. Recovery and restart procedures
      e. Graphic alarm presentation
      f. Use of report generator and generation of reports
      g. Data entry operator commands
      h. Alarm messages and reprinting formats
      i. System access requirements
      j. Service maintenance call procedures
   6. Maintenance Manual, which includes:
      a. Instructions for routine maintenance listed for each component, and a multi-page summary of component’s routine maintenance requirements
      b. Detailed instructions for repair of the security system
      c. A summary of the software licenses, including license numbers, quantity of clients, summary of the software options provided, and database capabilities
      d. A list of IP addresses used and with which system component they are associated, including MAC address
      e. A list of gateway addresses, subnet masks, DNS servers, and host name information
   7. Test Results Manual which includes the document results of tests, required under this Specification, organized by System, Floor, and Door.
8. As-Built Drawings, which includes 11"x17" prints of the as-built drawings.

D. As-Built Drawings
   1. Submit As-Built Drawings for review and approval at the completion of the project.
   2. As-Built Drawings shall fully and accurately represent installed systems and conditions, including: actual locations of devices and components, actual cable and terminal block numbering, and actual wire routing and wiring (wire type, gauge/size, rating, etc).
   3. Record changes in the work during the course of construction on blue or black line prints. Transfer construction mark-ups to AutoCAD or Revit format drawings at the completion of the project.
   4. Include the following additional information:
      a. Device addresses and IP address information
      b. Settings for each camera (lens specs, mm setting, auto shutter setting, and other available camera settings, etc.)
   5. Include approved Shop Drawings.
   6. Final acceptance requires the Engineer’s approval of the As-Built Drawings.

E. Owner’s acceptance, Substantial Completion, and start of the Warranty period requires all submittals above be approved and punch list deficiencies be corrected.

1.4 QUALITY ASSURANCE

A. Provide a project manager to coordinate the security system acceptance testing work with other trades.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SCHEDULING

A. Coordinate the security system Functional Testing and Acceptance Testing acceptance testing specific activities into the overall project construction schedule.

B. Provide the Engineer and Owner with a minimum one week notice prior to scheduling Functional Testing and Acceptance Testing activities.

3.2 TESTING REQUIREMENTS

A. Site Tests
   1. At a minimum, security system testing requirements shall include the following tests (where applicable to the project):
      a. Building Perimeter Test: Test doors, cameras, and devices related to securing the perimeter of the building.
      c. Data/IT Room Test: Test devices related to securing the MDF and IDF. Inspect system panels, power supplies, and other related security equipment located in these areas.
d. Access Control System Test: Test the software for correct programming and setup. Verify correct integration with the Intrusion Detection System.

e. Intrusion Detection System Test: Test the network connection and alarm dialer and duress stations for correct programming and operation. Verify correct arming/disarming functions from each keypad. Verify integration with ACAMS.

f. Video Surveillance System Test: Test the system for correct programming, operation, and alarm camera call-up.

g. Video Recording System Test: Test the recording system for correct programming, alarm recording, and event retrieval. Verify correct integration with the ACAMS and IDS system for alarm call-up. Test and verify the system is viewable from client workstations.

h. Other Readers/Door Test: Test remaining card readers and doors not included in the above tests.

i. Battery and UPS Load Test: Disconnect AC power to security system equipment to verify battery operation functions and system remains fully operational.

j. Door Hardware Test: Coordinate with the Division 08 door hardware contractor to resolve electrified locking door hardware failures and door alignment or door closer problems.

B. Site Tests Preparation
1. Provide device identification numbers that differ from or were not included on the original Construction Drawings.
2. Provide a complete systems point list.
3. During testing, provide technicians familiar with the installation to assist with the test. Stage the technicians as follows: one at the host, one at the device being tested, and one runner responsible to furnishing tools, step ladders, etc.
4. Provide radios for use by the Engineer and Owner during testing.
5. Provide pre-programmed access cards for use during testing. Provide one authorized card for each access level. Provide one card with no access authorization. Provide keys for lockset mechanical key override.

3.3 TEST PROCEDURES
A. Follow manufacturer’s written test procedures for each type of device and system.

3.4 FIELD DOCUMENTATION
A. Provide printed system documentation containing detailed wiring diagrams for each security equipment enclosure. Documentation shall include, at a minimum, layout of equipment, elevation detail, complete parts list, and complete wiring diagrams for each security system controller, input/output board, relay, and power supply.

B. Provide a printed service log for each security equipment enclosure. Service log shall include, at a minimum, columns for the following information: date of service, description of work performed, service technician(s), and service company.

C. Neatly fold the printed system documentation and service log and place it inside a clear plastic pocket affixed to the inside door of the security equipment enclosure.

3.5 TRAINING

A. Upon completion of the Acceptance Testing, provide training to the Owner’s representatives, at times convenient to them, in the function and operation as well as the service and maintenance of the security systems.

B. Utilize the production database for the training to give the users project-specific examples from which to learn.

C. Provide 16 hours, minimum, of on-site training by a factory trained representative. Maintain a sign-in sheet with names and dates of persons trained and forward to Owner upon completion of training.

END OF SECTION
SECTION 28 13 00
ACCESS CONTROL AND ALARM MONITORING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
1. ACAMS, including access control units, input/output units, and card readers
2. ACAMS power supplies
3. Alarm initiating devices, including: magnetic switch contacts, and request-to-exit sensors
4. Interface to electric door hardware and ADA door operators
5. Interface to Fire/Life-Safety system
6. Interface to other security subsystems with bi-directional communication

B. Products Furnished but not Installed under This Section
1. None

C. Products Installed but not Furnished under This Section
1. New electric feed-through power transfer hinges
2. Electrified locking hardware cable and termination to transfer hinge and security system

D. Products Furnished and Installed under Another Section
1. 120VAC power
2. Network switches, with Power over Ethernet (PoE)

E. Related Sections
1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a fully functional and completely operational system.
2. Section 08 71 00, "Door Hardware"
3. Section 28 00 00, "Basic Security Requirements"
4. Section 28 05 13, "Security System Cabling"
5. Section 28 05 53, "Security System Labeling"
6. Section 28 08 00, "Security System Acceptance Testing"
7. Section 28 23 00, "Video Surveillance System"
8. Section 28 16 00, "Intrusion Detection System"

1.2 REFERENCES

A. Comply with the References requirements of Section 28 00 00.

1.3 DEFINITIONS

A. Definitions as described in Section 28 00 00 shall apply to this Section.

B. In addition to those definitions in Section 28 00 00, the following list of terms as used in this specification defined as follows:
1. "A" and "AMP": amperes
2. "ACAMS": access control and alarm monitoring
3. "IDS": intrusion detection system
4. "LAN": Local Area Network
5. "NC": Normally closed
6. "NO": Normally open
7. "REX": request to exit
8. "SCS": security communications system
9. "UPS": uninterruptable power supply
10. "VAC": volts alternating current
11. "VDC": volts direct current
12. "VMS": video management system
13. "VSS": video surveillance system

1.4 SYSTEM DESCRIPTION

A. General: Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working Access Control and Alarm Monitoring system installation, as described in these specifications.

B. Access Control and Alarm Monitoring System (ACAMS) Overview
   1. ACAMS is a distributed network of control panels connected to and programmed from a central server and client workstation(s). The ACAMS is utilized for electronically controlling access within the building for employees, visitors, delivery personnel, and persons.
   2. ACAMS consists of an ACAMS server/host computer, ACAMS client workstations/computers, field panels, card readers and alarm initiating devices (refer to the drawings for locations of field panels, card readers, and other devices). The server will communicate with the control panels via the Owner's LAN and/or hardwire connections. The control panels control the electronic door hardware allowing or disallowing passage through a controlled door or gate.
   3. The ACAMS will provide secondary monitoring of the IDS.

C. ACAMS Server and Software
   1. Utilize existing ACAMS Server and ACAMS software located at Contra Costa Community College District Office.
   2. Provide interface to the IDS. Program ACAMS software to receive alarm events from the IDS for bi-directional monitoring.
   3. Provide software interface to VSS to provide automatic camera call-up for associated alarm events.

D. ACAMS Panels and Power Supplies
   1. Provide access control panels, including enclosures, wireway, enclosures, wiring duct, panels, daughter boards, wiring, connectors, and other components for a complete system.
   2. Provide input and output modules as required to fulfill the project's requirements.
   3. Provide power supplies for power to ACAMS panels, field devices, door locks, motion detectors, indicator lamps, etc. Provide separate power supplies dedicated for lock power. Other devices such as REX’s and alarm horns may be combined on common power supplies.
   4. Provide battery backup for power supplies and system components.
   5. Provide tamper switches within each security equipment enclosure and wireway, each security junction box, and each door junction box. Program ACAMS for monitoring and alarming (unsupervised inputs for this purpose).
   6. Provide real-time monitoring of power supplies and batteries. Connect power supplies to ACAMS panel as an input. Program ACAMS for monitoring and alarming (unsupervised inputs for this purpose).
E. Card Readers / Door Devices
   1. Provide multi-technology card readers, including rough-in, wiring, reader, and other components for a complete system and connect to the ACAMS. Provide tamper switches per card reader wired/connected to the ACAMS input module.
   2. Provide door contacts and request-to-exit motion detectors for card reader controlled doors and connect to the ACAMS. Refer to drawings for configurations and instances.
   3. Provide double pole double throw contacts on doors controlled by card readers with associated IDS alarm monitoring keypads. Wire one contact to the serving ACAMS panel and connect to the ACAMS panel as an input.
   4. Provide door contacts for non-card reader controlled doors noted on drawings (such as ground floor perimeter doors) and connect to the ACAMS. ACAMS shall monitor these doors. Program the ACAMS to alarm should the monitored doors open when not authorized.

F. Provide end of line resistors as required (e.g., on supervised lines).

G. Provide interface to ADA automatic/power assist door operator and corresponding actuator push plates

H. Extra Materials
   1. Furnish 10% spare parts of total installed the following (round up to the next complete device):
      a. Access controller boards
      b. Input expansion modules
      c. Output expansion modules
      d. Reader interface modules
      e. Card readers
      f. Power supply boards
      g. Relays
   2. Fuses: 5 of each type of fuse

1.5 SUBMITTALS

A. Quantity: Furnish quantities of each submittal as noted in Section 28 00 00.

B. Contractor Qualifications: Submit certification letters for the manufacturer of the ACAMS.

C. Product Data: Submit product information for components specified herein.

D. Shop Drawings: Include the following, minimum:
   1. Device placement on floor plans and RCPs
   2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
      a. ACAMS control panel
      b. ACAMS card reader and input/output modules
      c. ACAMS power supplies
      d. Card Readers
      e. Door and lock position monitoring contact switches and request-to-exit sensors
      f. Interface to electrified door hardware
      g. Cable conductors (identify conductors on the point to point diagrams with the same tag as the installed conductor)
      h. Miscellaneous control relays
   3. Block Diagram/Riser Diagram: Show ACAMS components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
4. Schedules: Include schedules for ACAMS control panels that show each point ID with a description of the connected devices.
5. Include user interface graphics with icons and control buttons displayed.
6. Include custom mounting details.

E. Submittal Description: Training Submittal
1. Format: PDF
2. Contents:
   a. Cover sheet, showing:
      1) Owner Name
      2) Project Name and Address
      3) Project Submittal Number
      4) Submittal Name
      5) System Name
      6) Specification Section Number (e.g., “Section 281300”)
      7) Date of Submittal. Format: Month Day, Year (e.g., “January 1, 2016”)
      8) Contractor Name
   b. Table of Contents
   c. Training Schedule
   d. Training Course outline/ agenda
   e. Course materials and training manuals for the following users as applicable:
      1) System Administrator
      2) Security staff
      3) Operator, and nurse/staff.

F. Submittal Requirements at Closeout:
1. As-Built Drawings: submit as-built drawings that includes approved block diagram, riser diagram, wiring diagram, security control room layout and elevations, floor plans, and reflected ceiling plans, and site plans showing device locations.
2. O&M Manual: submit O&M Manual as a binder or soft copy (bookmarked PDF) including the following, at a minimum:
   a. Product data – approved submittals (‘cleaned up’) and electronic
   b. As-built drawings, printed to 11x17 / tabloid landscape and electronic PDF files and native files (DWG or RVT) on storage media
   c. Warranty statement and service protocol (guidelines, contact numbers, etc.)
   d. Maintenance requirements
   e. Station Matrix, printed to 11x17 / tabloid landscape and electronic PDF files and native XLSX file on storage media
   f. Include information for the network switches and ports.

1.6 WARRANTY

A. Warrant work and the system to perform as described within this Section for a period of one year from the date of system acceptance. The warranty shall cover system operation/performance, parts, and labor. During the warranty period, respond within 4 hours and correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Access Control and Alarm Monitoring System
1. Software House | Tyco Security Products to match campus standard
2.2 SECURITY EQUIPMENT ENCLOSURES AND DEMARCATION ENCLOSURES

A. Refer to 28 00 00 for product requirements.

2.3 SLOTTED WIRING DUCT

A. Refer to 28 00 00 for product requirements.

2.4 WIREWAYS

A. Refer to 28 00 00 for product requirements.

2.5 POWER SUPPLIES/Battery CHARGERS

A. Power supplies shall be UL Listed and suitable for the purpose of powering ACAMS controllers, reader boards, intrusion detection panels, electric locks, and field devices (such as REXs, local alarms, etc.). Power supplies shall also be suitable for continuous charging of batteries (for power back up).

B. Description / Features:
   1. Input: 120 VAC, hard-wired
   2. Output: sixteen 12 VDC and/or 24 VDC, 10 A continuous current, PTC Class 2 rated power limited
   3. Fire alarm disconnect, individually selectable per output
   4. Short circuit and thermal overload protection
   5. Fail Safe and/or Fail Secure power outputs, individually selectable per output
   6. LEDs indicate outputs triggered
   7. Integrated battery charger
   8. Monitor loss of input power and alarm in the Access Control System
   9. Manufacturers, or equal:
      a. Altronix MAXIMAL Series; 12 VDC and 24 VDC dual power supply
      b. LifeSafety Power #FPO150-C8E1; 12 VDC power supply
      c. Securitron #AQD6-8F; "AccuPower" switching power supply, 8-output
      d. Securitron #AQD6-8F8R; "AccuPower" switching power supply, 8-output with relays

2.6 BATTERIES

A. Batteries shall be UL Listed and suitable for the purpose of backing up power to security system equipment, field devices, electric locks, etc.

B. Description / Features:
   1. Voltage: 12 VDC
   2. Amps: 12 A
   3. Chemistry: SLA or VRLA
   4. Termination: Spade protected terminals

C. Manufacturer, or equal:
   1. Interstate Batteries #SLA1105 sealed lead acid 12V 12Ah battery
2. Yuasa Battery Inc #RE12-12 sealed lead acid 12V 12Ah battery

2.7 ACCESS CONTROLLERS

A. Description / Features:
   1. An intelligent controller with integrated battery backup, database, and communication ports that supports 16 card readers
   2. Supports HID proximity, MIFARE, and DESFire card reader formats
   3. Expansion capacity/additional modules (e.g., for additional memory and/or for future feature enhancements)
   4. Supports flash upgrades for firmware updates
   5. Global input/output and anti-passback functionality
   6. Capable of utilizing keypad commands to activate/deactivate events
   7. Monitor Inputs: Station switch, tamper, power fail, and alarm

B. Functions:
   1. Central control for attached devices
   2. Makes decisions for access
   3. Responds to monitor activity
   4. Receives input to control its decision making
   5. Reports activity to other devices

C. Mounting: within wall mounted NEMA enclosure

D. Power:
   1. Main Power Source: controller shall be powered from the associated power supply unit
   2. Battery Backup: the controller board shall have an integrated low voltage battery (such as a lithium cell) to maintain internally stored database and setup in case main power is interrupted

E. Self-Protection: Controller shall detect power input failures and tampering

F. Communications
   1. TCP/IP via 10Base-T/100Base-TX
   2. Supports multiple communication channels to which a variety of devices can connect – RS-485, RS-422, or 20mA communications to addressable modules:
      a. Input Module: Supports 8 Class A supervised input points
      b. Output Module: Supports 8 Form C dry contact relays
      c. Reader Interface Module: Supports 2 card readers with associated alarm contacts, request-to-exit devices, and lock outputs

G. Manufacturer:
   1. Software House “iSTAR” series to match campus standard
      a. #iSTAR PRO 64MB control panel

2.8 MONITOR INPUT/RELAY OUTPUT BOARDS

A. Description
   1. Monitor Input: module that monitors inputs that occur over network and sends them via RS-485 protocol to the Controller.
   2. Relay Output: executes relay commands received from the Controller via RS-485 protocol.
   3. Monitor Inputs: 8, minimum, four-state monitor points
4. Relay Outputs: 8, minimum, normally opened (NO) or normally closed (NC)

B. Manufacturer, or equal:
   1. Input Module:
      a. Software House #I/8
   2. Output Module:
      a. Software House #R/8

2.9 CARD READERS

A. Description / Features:
   1. FCC and CE certified, and conform to the following ISO standards:
      a. 15693 (CSN read-only)
      b. 14443A (CSN read-only)
      c. 14443B (CSN read-only)
   2. Capable of reading the following frequencies and card formats:
      a. 125 kHz and 13.56 MHz
   3. Utilize a Wiegand protocol for communication for compatibility with standard access control systems.
   4. Multi-color LED and an audible sounder to indicate the status of the door
   5. For exterior locations, reader shall be fully weatherized with a rugged, polycarbonate enclosure, designed to withstand an operating temperatures of -22 to 150 degrees Fahrenheit (-30 to 65 degrees Celsius) and operating humidity of 5-95% non-condensing.

B. Functions:
   1. Card reader shall continuous emit radio radiation with a continuous sensing of an access card.
   2. Upon reading an access cord, the card reader shall initiate a single transmission to the ACAMS controller.
   3. Upon receiving status from the ACAMS controller, the card reader shall change the state of the LED to the programmed state.

C. Manufacturer, or equal:
   1. HID multiCLASS series
      a. Wall mount: HID SE Series; multi-technology card reader
      b. Wall mount with keypad: HID SE Series with keypad; multi-technology card reader with integrated keypad
      c. Mullion style: HID SE Series mullion; multi-technology card reader

2.10 MAGNETIC CONTACT SWITCHES

A. Magnetic contact switches shall be UL 634 Listed.

B. Wood, Steel, and Hollow Metal Doors
   1. Description / Features
      a. Mounting: Recessed
      b. Switch Type: Double Pole, Double Throw
      c. Gap Distance: 0.5” maximum
   2. Manufacturer, or equal:
      a. Interlogix #1078C; 3/4” dia., closed-loop contact switch, with leads
      b. Magnasphere #MSS-19CL; 3/4” dia., open loop contact switch, with leads
      c. Magnasphere #HSS-L2C; UL 264 Level 2 high security recessed contact switch, with leads
2.11 REQUEST-TO-EXIT SENSORS

A. General
1. Power: 12 or 24VDC, 35mA
2. Relay Output: 2 form “C” contacts
3. Adjustable relay latch time
4. Programmable retrigger or non-retrigger mode
5. Radio Frequency Interference (RFI) Immunity range from 26 to 1,000 MHz at 50 v/m

B. Manufacturer, or equal:
1. Bosch #DS160 with TP160 trim plate
2. Honeywell #IS320WH with IS310WHTP trim plate
3. Interlogix #RCR-REX motion sensor REX

2.12 INTERFACE RELAYS

A. Refer to section 28 00 00 for relay product requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General
1. Install equipment per manufacturer’s instructions.
2. Install devices, stations, etc., square and plumb. Set flush-mounted units so that the face of the cover, bezel, or escutcheon matches the surrounding finished surface.
3. Install so that there are no gaps, cracks, or obvious lines between the trim and the adjacent finished surface.
4. Install to heights shown on drawings. Heights shall comply with applicable ADA requirements.
5. Provide supervisory and end of line resistors as required.

B. ACAMS Control Panels (Reader Board, Input/Output Boards)
1. Install security equipment enclosures and wireway to best suit the system layout and to properly manage wiring and connections.
2. Ensure cuts, knock-outs, punches, etc. have no sharp edges.
3. Install power supplies and associated hardware in same location.

C. Card Readers
1. Install card reader to the rough-in, not directly to dry wall.
2. Connect readers directly to reader boards. Do not daisy chain readers together.
3. Cable Requirements:
   a. 6-conductor 22 AWG stranded shielded cable for signal.
   b. 1-pair 22AWG stranded shielded cable for device power.
4. Wire the card reader’s multi-color LED to indicate the following status of the door.
   a. Red = the door is secure (locked).
   b. Green = the door is unsecured (unlocked).
   c. Yellow = the card reader is not functioning (off-line/trouble), is processing a read request, or has denied access.
5. Wire/program the card reader to produce an audible beep tone to indicate to the user:
   a. The card was read and/or access was denied.
   b. Door is being held open and needs to be closed.
D. Four-State End-of-Line (EOL) Supervision
   1. Provide designated resistors at device end of line per manufacturer's EOL recommendation to provide four-state supervision of security device and cabling.
   2. Provide EOL supervision for alarm contacts, local alarm sounders, REXs, motion detectors, glass break detectors, help/duress buttons, and other designated security devices connected to the ACAMS and IDS.
   3. Program ACAMS with the following states of supervision:
      a. Contact closed = Secure
      b. Contact open = Alarm
      c. Short circuit = Line fault
      d. Open circuit = Line fault
   4. All NO/NC circuits shall be wired NC.

E. Door Hardware
   1. Setup and conduct a door hardware coordination meeting.
   2. Coordinate the installation and termination of the security cable with the installation of the electric door hardware and transfer hinge.
   3. Route power to electrically controlled locks on Life-Safety doors through fire alarm output to automatically unlock the door upon activation of Fire/Life-Safety system. Connect fire alarm output to the disconnect relay on the associated 24VDC lock power supply.
   4. Provide cable and terminate wires to delayed egress devices for monitoring activation of delayed egress by the ACAMS system.

F. Door Contacts
   1. Install 6" from latch side of door.

G. Request-To Exit Motion Detectors
   1. Install motion detector on the secured (protected) side of door. Install so that its detection pattern is not obstructed by exit signs, light fixtures or other objects that would interfere with proper operation.
   2. Adjust relay hold time and pattern to properly detect valid exit and allow shunting of door contact.
   3. Adjust detection sensitivity to pulse.
   4. Mask detector lens to provide a confined detection area limited to the door handle or push bar.
   5. Run wire inside structural tube steel frame into back of conduit body for cage locations.

H. Low voltage transformers
   1. Install low voltage transformer in security junction box to prevent tampering. Coordinate with Division 26 for location of outlet in junction box.

3.2 PROGRAMMING

A. Prior to the completion of construction, schedule a meeting with the Owner to determine the programming criteria. Document the results of the meeting and perform necessary programming to achieve the Owner's requests. During the meeting, discuss the following:
   1. Access card levels and door groupings
   2. Alarm priority levels
   3. Schedules and time codes
   4. Holidays and holiday types (priorities)
   5. Action/responses from individual input points
   6. Standard and custom (expanded) reports
   7. Defining alarm messages and standard response messages applicable to site
8. Routing of alarm points to selected pagers
9. Routing of alarm points to operator’s workstations, printers, and history files
10. Owner’s graphics – develop sample graphic complete with icons and text. Alarms to appear on building floor plans depicting the nature and location of alarms. Review and revise graphic layout as required by Owner.
11. System database backup procedures
12. Video integration camera call-up

B. Program and setup the system such that no additional programming other than entering new access cards is required. Include setup of available features of the software.

C. Import Owner’s cardholder database.

D. Using CAD drawing files of floor plans, perform the following relative to system graphics:
   1. Delete non-applicable drawing layers and details to arrive at simple floor plans of the building as built.
   2. Convert drawings to a graphic file format compatible with the Owner’s access control and alarm monitoring system.
   3. Load drawing files into the system.
   4. Apply new and predefined icons and other points on each graphic to indicate point and control status.
   5. Link graphic images/icons to represent reader, monitor, alarm initiating devices, and control points.
   6. Program device icons on plans with functionality.
   7. Create camera call-up events.
   8. The point names shown on the as-built drawings shall match the system point schedule.

E. Program ACAMS such that alarm events generate email notification to offsite addresses via the Internet. Also, as required by the Owner, program ACAMS such that alarm events generate pages.

F. Program customized client workstation log-ins (restrict functions by user privileges).

G. Program routing of monitor and control points. Route activations and restore messages to one or more of the following locations as directed by the Owner’s Representative:
   1. One or more system workstations
   2. One or more system printers
   3. One or more alphanumeric pagers
   4. History files in addition to the above
   5. History files only

H. Program the system such that reliance on a remote host for routine building operations, such as scheduled door commands and conditional events, are minimized to the greatest extent possible and decisions are made at the local building controller.

I. System Operation, Alarm and Reporting Function: Program door control panel tamper switches to immediately report as a separate “tamper” point to the system resulting in an alarm condition displayed in both text and graphic form on the applicable workstation(s) and an alarm message transmitted to the appropriate pager(s).
J. Program the system in a manner that minimizes the amount of time required for the users to make updates and maintain the system on a daily basis especially updates that impact card holder record updates. Nested programs, such as reader groupings used in access codes, shall be used to the greatest extent possible such that single actions are required to update an entire card data population. If there is a question regarding the appropriate approach to programming, given the flexibility of most systems, contact the Engineer prior to any initial programming.

K. Perform 2 full system back-ups at completion of initial programming and deliver one copy to owner with letter of Transmittal explaining information included in back-up and brief description of recovery procedures. Label the second removable storage device and store onsite. Perform back-ups on a regular bases through the remainder of the project.

L. Customize menus with the assistance of the factory to “gray-out” features not used on project (such as elevator control).

M. Perform field software changes after the initial programming session to “fine tune” operating parameters and sequence of operations based on revised operating requirements.

N. Password management – refer to Section 280000.

3.3 EXTRA MATERIALS

A. Furnish extra materials to Owner. Produce a transmittal with an itemized list including quantities, recipient, and receipt date. Submit copy of Owner-signed transmittal with project closeout documents.

B. Place fuses inside each equipment/panel and power supply enclosure.

C. Turn over keys (equipment enclosures, low voltage power supplies, security junction boxes, rack cabinets, etc.) to the Owner. Produce a transmittal with an itemized list of keys, recipient, and receipt date. Submit copy of Owner-signed transmittal with project closeout documents.

3.4 TRAINING

A. Combine training on the ACAMS with training on the IDS (Section 281600) and the VSS (Section 282300).

B. Training Requirements
   1. Security Staff/System Operators:
      a. Prior to the first day of business at the new facility, provide 1 day of training, 4 hours per day.
   2. Administrators:
      a. Three weeks later; provide 1 day of training, 4 hours per day.

3.5 TESTING

A. Test ACAMS in accordance with Section 28 08 00.

END OF SECTION
SECTION 28 16 00
INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Intrusion Detection System
   2. Interface to other security systems with bi-directional communication

B. Products Furnished but not Installed under this Section:
   1. None

C. Products Installed but not Furnished under this Section:
   1. None

D. Products Specified but not Installed under this Section:
   1. None

E. Products Furnished and Installed under another Section:
   1. 120VAC power
   2. Analog phone line (for alarm dial out)
   3. Cellular service (for wireless backup)
   4. Network Connection (LAN / IP network / switches)

F. Related Sections:
   1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 28 00 00, "Basic Security Requirements"
   3. Section 28 05 13, "Security System Cabling"
   4. Section 28 05 53, "Security System Labeling"
   5. Section 28 08 00, "Security System Acceptance Testing"
   6. Section 28 13 00, "Access Control and Alarm Monitoring System"

1.2 DEFINITIONS

A. Definitions as described in Section 28 00 00 shall apply to this section.

B. In addition to those Definitions of Section 28 00 00, the following list of terms as used in this specification defined as follows:
   1. "A" and "AMP": amperes (electrical current)
   2. "ACAMS": access control and alarm monitoring system
   3. "IDS": Intrusion Detection System
   4. "LAN": local area network
   5. "LCD": liquid crystal display
   6. "REX": request-to-exit
   7. "VAC": volts alternating current
   8. "VDC": volts direct current
   9. "VSS": Video Surveillance System
1.3 SYSTEM DESCRIPTION

A. General: Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working intrusion detection system installation, as described in these specifications and shown on the associated drawings.

B. System Overview:
   1. The IDS is a network of distributed control panels and monitoring devices covering multiple areas that can be armed and disarmed independently of each other (alarm zones). Though interconnected, the IDS is a separate system from the ACAMS and is utilized for monitoring the designated interior spaces and for generating alarms.
   2. The IDS consists of control panels, communicators, keypads, and field devices (refer to the drawings for locations).
   3. Activation of the IDS shall notify the central monitoring.

C. Intrusion Detection System
   1. Provide an IDS control panel with integrated digital communicator with connections to the LAN and to a dedicated outside phone line for remote monitoring by contracted central monitoring station and. Provide wireless back up.
   2. Provide 12 VDC power supplies dedicated to IDS to power control panels and keypads. Provide battery backup associated with the power supplies system to keep the IDS operating for a minimum of 8 hours in the event of a utility power failure or emergency. Provide connection between power supplies and ACAMS to monitor power supply status and battery status. Program as unsupervised inputs for this purpose.
   3. Provide expansion input modules to the IDS panels as necessary to support the field devices shown on the drawings.
   4. Provide keypads to allow security and authorized staff arming and disarming of the IDS. Refer to drawings for quantity and locations. Keypad name brand shall match that of the control panel.
   5. Interface with ACAMS
      a. Connect designated ACAMS alarm outputs to the IDS control panel. Provide expansion input modules to the IDS panels as necessary to support input from the ACAMS.
      b. Provide software interface with the ACAMS.

D. Tamper Monitoring
   1. Provide tamper switches within each IDS control panel enclosure, IDS power supply enclosure, and associated wireway. Connect tamper switches to IDS control panel as monitor input points. Program these input as unsupervised inputs for this purpose. Coordinate this work with section 28 13 00 (as this section also requires tamper switches location within control panels, power supplies, and wireway).

1.4 SUBMITTALS

A. Product Data: Submit product information for the intrusion detection systems, including:
   1. Controller
   2. Digital communicator
   3. Power supplies, with power supply sizing calculations
   4. Door contacts
   5. Cellular backup

B. Shop Drawings: Submit shop drawings containing the following:
   1. Device placement on floor plans
2. Block and riser diagrams
3. Custom mounting details

PART 2 - PRODUCTS

2.1 IDS CONTROL PANEL

A. IDS control panel and associated components, when assembled, shall be UL listed for Central Station, Local, Police Station Connect, Holdup, Bank Safe and Vault, Mercantile Safe and Vault, and Household Burglar Alarm and Encrypted line Security when communicating via a network.

B. Description / Features:
1. Zones: up to 64 individually addressable alarm zones and 8 programmable areas/partitions
2. 8, minimum, on-board supervised inputs
3. Programmable and supervised relay outputs
4. Capacity for expansion and relay output modules
5. Dialout:
   a. Multiple telephone numbers storage/programmability
   b. Primary and duplicate dialouts (for main and alternate destinations)
   c. Capable of utilizing a dual phone line switcher to monitor 2 phone lines
   d. Phone line monitor (loop or ground start)
6. Ethernet/TCP/IP connectivity capable integrated digital communicator
7. Reporting: capable of automatically issuing test and status reports
8. Support RS-232 connectivity to third party devices for automation
9. Enclosure: UL listed, lockable

C. Manufacturer, or equal:
1. DSC PowerSeries
   a. #PC1664 8-64 zone control panel
   b. DSC #PC5200 Power Supply Module
   c. DSC #PC5204 Power Supply Module
   d. DSC # PC5100 Addressable Xone Expander
   e. DSC # PC5108 8-Hardwire Xone Expander
   f. DSC # PC 5208 Programmable Output Module
   g. DSC # IT-100 Integration Module
   h. Lantronix # UDS1100 w/ #500-163-R cable adapter
   i. DSC #TL250GS Internet Alarm Communicator

2.2 WIRELESS COMMUNICATOR

A. Wireless communicator shall operate on 3G/4G networks as a back-up communications channel if the wired phone port cannot function properly.

B. Wireless communicator shall meet the requirements for UL Commercial Fire, as well as UL Listed for Residential Burglary and Fire applications.

C. Wireless communicator shall meet applicable FCC requirements.

D. Enclosure:
1. Metal
2. Key-locking
2.3 SLOTTED WIRING DUCT

A. Refer to section 28 00 00 for slotted wiring duct product requirements.

2.4 WIREWAYS

A. Refer to section 28 00 00 for wireway product requirements.

2.5 POWER SUPPLIES

A. Refer to section 28 13 00 for power supply product requirements.

2.6 BATTERIES

A. Refer to section 28 13 00 for battery product requirements.

2.7 KEYPAD

A. Keypads shall the control panel.

B. Keypads shall come equipped with the following:
   1. LCD, 2 text lines (minimum), 16-character per line (minimum)
   2. Backlighted multi-key touch pad
   3. Keys light on entry or key press
   4. Audible annunciator (e.g., piezo buzzer) for audible feedback
   5. User-controlled/adjustable brightness and loudness

C. Keypads shall provide the ability to display for each detection point the following:
   1. Alarm
   2. Trouble
   3. Supervisory
   4. Faulted
   5. Custom text

D. Keypads shall display system-wide events, including:
   1. Local system test
   2. Sensor reset
   3. Event log

E. Manufacturer, or equal:
   1. DSC #PK5500 64-Zone LCD Full-Message Keypad

2.8 MAGNETIC CONTACT SWITCHES

A. Refer to section 28 13 00 for magnetic contact switch product requirements.

PART 3 - EXECUTION
3.1 INSTALLATION

A. General
1. Install equipment per manufacturer’s instructions.
2. Install devices, stations, etc., square and plumb. Set flush-mounted units so that the face of the cover, bezel, or escutcheon matches the surrounding finished surface.
3. Install so that there are no gaps, cracks, or obvious lines between the trim and the adjacent finished surface.
4. Install to heights shown on drawings. Heights shall comply with applicable ADA requirements.
5. Provide supervisory and end of line resistors as required.
6. At control panels, place and route wiring within wireway and enclosures; do not leave wiring exposed. Within enclosures, route wiring within wire management apparatus, such as slotted wiring duct.

B. IDS Control Panel and Power Supply
1. Install IDS enclosure on wall within the ACAMS enclosures and wireway infrastructure.
2. Install control panel and associated expansion boards within IDS enclosure. Include standoff brackets and other accessories to mount control boards to perforated panel within enclosure.
3. Connect IDS control panel, expansion modules, etc., to associated power supply. Do not power IDS control panels via plug-in transformers.
4. Install power supply and associated hardware adjacent to the IDS panel.
5. Coordinate connection of phone jacks in IDS control panel (for communications to the contracted central station) to designated phone lines.

C. Wireless Back-Up:
1. Locate antenna (or antennas) as determined by site cell coverage conditions.

D. Keypads:
1. Coordinate final locations (exact placement) prior to rough-in and installation.

3.2 PROGRAMMING

A. Prior to the completion of construction, schedule a meeting with the Owner to determine the programming criteria. Document the results of the meeting and perform necessary programming to achieve the Owner’s requests. During the meeting, discuss the following:
1. Alarm priority levels
2. Zone or alarm point descriptions
3. User authority levels to arm/disarm areas or alarm partitions
4. Alarm notification requirements
5. Action/responses from individual input points
6. Defining alarm messages and standard response messages applicable to site
7. Interface requirement with ACAMS and VSS
8. Central station requirements, response from individual alarm points, password, and call list information
9. Auto arm/disarm schedules
10. Schedules and time codes
11. Holidays and holiday types (priorities)
12. Standard and custom (expanded) reports
13. System database backup procedures

B. Program and setup the system such that no additional programming other than entering new access codes is required.
C. Use the point names provided on the system point schedule.

3.3 EXTRA MATERIALS

A. Furnish extra materials to Owner. Produce a transmittal with an itemized list including quantities, recipient, and receipt date. Submit copy of Owner-signed transmittal with project closeout documents.

B. Place fuses inside each equipment/panel and power supply enclosure.

C. Turn over keys (equipment enclosures, low voltage power supplies, security junction boxes, rack cabinets, etc.) to the Owner. Produce a transmittal with an itemized list of keys, recipient, and receipt date. Submit copy of Owner-signed transmittal with project closeout documents.

3.4 TRAINING

A. Combine training on the IDS with training on the ACAMS (refer to section 28 13 00).

3.5 TESTING

A. Perform acceptance testing to the intrusion detection system in accordance with Section 280800.

END OF SECTION
SECTION 282300
VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Video Surveillance System (complete system)
   2. Fixed cameras, lenses, mounts, and housings

B. Products Furnished But Not Installed Under This Section
   1. None

C. Products Installed But Not Furnished Under This Section
   1. None

D. Products Specified But Not Installed Under This Section
   1. None

E. Products Furnished And Installed Under Another Section
   1. 120VAC power
   2. Telecommunication cabling between IDF room and cameras; refer to Section 27 151 13.

F. Related Sections
   1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 27 15 13, "Communications Horizontal Cabling"
   3. Section 28 00 00, "Basic Security Requirements"
   4. Section 28 08 00, "Security System Acceptance Testing"
   5. Section 28 05 13, "Security System Cabling"
   6. Section 28 05 53, "Security System Labeling"
   7. Section 28 13 00, "Access Control and Alarm Monitoring System"
   8. Section 28 16 00, "Intrusion Detection System"

1.2 REFERENCES

A. Comply with the References requirements of Section 28 00 00.

B. In addition to the codes and standards listed in Section 28 00 00, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
   1. Underwriters Laboratories (UL): Applicable listing and ratings

1.3 DEFINITIONS

A. Definitions as described in Section 28 00 00 shall apply to this Section.

B. In addition to those definitions in Section 28 00 00, the following list of terms as used in this specification defined as follows:
1.4 SYSTEM DESCRIPTION

A. General: Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction, and special or occasional services as required to make a complete working video surveillance system, as described in this specification.

B. Video Surveillance System (VSS) Overview
1. The VSS is an enterprise-wide system generally comprised of fixed cameras (with associated mounting apparatus, housings, cabling, etc.), video management system (software), and network video recorder and storage (hardware), that provides live video feeds for real-time surveillance and monitoring, recorded video for forensic analysis, and (in some cases) intrusion detection through video analytics.
2. The VSS serves as the video component of the facility’s overall security and safety program. Camera deployment and their respective field-of-views are strategically determined to coincide with points of security and access control as well as surveillance of open and high-security spaces.
3. The VSS interconnects and integrates with the ACAMS, IDS, and security/emergency communications system such that alarms/events generated within the other systems (generally carried through the ACAMS) cause VSS and the VMS to behave in a programmed manner.
   a. Program active icons in graphic user interface map in the ACAMS to allow camera call up based on the selection of icon.

C. Video Surveillance System (VSS) Scope
1. Video Management System Software: Provide VMS licenses in a quantity sufficient to support the project’s cameras and client workstations plus 20% (minimum, round up to nearest whole number).
2. Program the software system to meet the project requirements including programming recording input points, video call up, and other aspects of the system. Provide software interface to the ACAMS and IDS for alarm call up of cameras on predefined alarm events.
3. Provide cameras as shown on the drawings. Provide outdoor housing and mounts for exterior cameras.
4. Provide power supplies to supply power to cameras. Do not combine with ACAMS power supplies.

D. Tamper Monitoring: Provide one tamper switch within each dome enclosure to monitor the enclosure, including wiring, connection to ACAMS panel; and programming this tamper switch into ACAMS system as monitor input point.

1.5 SUBMITTALS

A. Contractor Qualifications: Submit certifications for the manufacturers of the video surveillance equipment.

B. Product Data: Submit product information for components specified herein.

C. Shop Drawings:
   1. Device placement on floor plans.
   2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
      a. Video surveillance system, monitors, and recording equipment
      b. Network Switches
      c. Devices connected to the system
      d. Miscellaneous control relays
      e. Conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)

3. Camera Matrix: Submit as an Excel-compatible spreadsheet a matrix that includes each camera. The matrix, using the same ID as shown on the as-built drawings, shall include the following column headers, at a minimum:
   a. Device
   b. Device Identifier
   c. Location
   d. MAC Address
   e. IP Address
   f. IDF Room
   g. Network Switch
   h. Switch Port

4. Block Diagram/Riser Diagram: Show the video surveillance system components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.

5. User interface graphics with icons and control buttons displayed.

6. Custom mounting details

D. Submittal Requirements at Closeout:
   1. As-Built Drawings (this may be combined with the ACAMS as-built drawings): submit as-built drawings that includes block diagram, riser diagram, wiring diagram, reflected ceiling plans and site plans showing camera locations (tagged with a unique ID per camera).
   2. Camera Matrix: submit as an Excel-compatible spreadsheet a matrix that includes each camera. The matrix, using the same ID as shown on the as-built drawings, shall include the following column headers, at a minimum:
      a. Camera Type
      b. Camera ID (shall match the as-built plans)
      c. Camera manufacturer and model (shall match the approved product data submittal)
d. Camera lens manufacturer and model (shall match the approved product data submittal)
e. Location
f. MAC Address
g. IP Address
h. IDF Room
i. Network Switch
j. Switch Port
k. Maintenance requirements

3. O&M Manuals: submit O&M Manual as a binder or soft copy (bookmarked PDF) including the following, at a minimum:
   a. Product data – approved submittals (‘cleaned up’) and electronic
   b. As-built drawings, printed to 11x17 / tabloid landscape and electronic PDF files and native files (DWG or RVT) on storage media
   c. Warranty statement and service protocol (guidelines, contact numbers, etc.)
   d. Maintenance requirements
   e. Station Matrix, printed to 11x17 / tabloid landscape and electronic PDF files and native XLSX file on storage media
   f. Network switches and ports configuration information

1.6 WARRANTY

A. Warrant the system for a period of one year from the date of system acceptance. The warranty shall cover system operation/performance, parts, and labor. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 CAMERAS

A. Fixed IP Interior Dome Camera
   1. Type: Color, vandal-resistant
   2. Power: PoE
   3. Imager: 1/3 inch format, unless otherwise noted
   4. Lens Mount: Accept a “CS” mount auto or manual-iris lens
   5. Resolution: 1080p HD
   6. Minimum Light Level: 0.1 fc imager illumination at full video, unless otherwise noted
   7. Lens: 3 to 9mm, unless otherwise noted
   8. Frame Rate: 30fps at H.264
   9. Manufacturer, or equal:
      a. Axis #P3346-V IP dome megapixel camera
      b. Sony
   10. Accessories, or equal:
       a. Axis #5502-781 ceiling mount kit
       b. Axis #5502-401 mounting plate
       c. Sony

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION PLANNING

A. Prior to the completion of construction, schedule a meeting with the Owner and the Engineer to determine the system programming requirements, such as the following:
1. Camera naming/numbering
2. Field of view per camera
3. Settings for contrast, wide dynamic range, and auto-iris
4. Camera call-up and recording features, including video motion detection

B. Camera Locations
1. Prior to installation, coordinate/confirm camera locations. As needed, perform a field walk with the Owner. Obtain Owner signoff of camera locations and field of view per camera prior to installation.
2. Prior to rough-in construction, coordinate rough-in locations and requirements per camera.

3.2 INSTALLATION

A. Cameras
1. Field determine exact placement of cameras to ensure complete coverage.
2. Field determine fixed camera lens size to ensure complete coverage.
3. For exterior cameras, provide liquidtight flexible metallic conduit from junction box to camera housing and connect from below.

3.3 PROGRAMMING

A. Network Video Recorder
1. Configure the cameras and servers at the following initial requirements:
   a. Codec: H.264
   b. Resolution: Maximum resolution supported by the camera
   c. Storage: 30 Days (minimum)
   d. Recording: Continuous
   e. Frame Rate: 15fps

B. Document the results of the meeting and perform necessary programming to achieve the Owner's requests.

C. Setup and program the system such that no additional programming required.

D. Use the camera naming convention agreed upon at in the programming meeting when programming point names into the system.

E. Perform two full system back-ups at completion of initial programming and deliver one copy to the Owner with a letter of transmittal explaining information included in back-up and brief description of recovery procedures. Perform back-ups on a regular bases through the remainder of the project.

3.4 TESTING

A. Test the video surveillance system in accordance with Section 280800.

3.5 SYSTEM OPERATION CONFIRMATION

A. At 30 days after substantial completion, perform field review of video surveillance system software with the Owner to "fine tune" configuration settings for resolutions, recording, and frame rate to meet the storage and operational requirements.
END OF SECTION
SECTION 28 31 00

FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install Fire Alarm System including all wiring and connections and other materials as shown on Plans and specified herein. It is the intent that a complete operating system conforming to all applicable codes be installed and that any power supplies, relays, resistors, cards, modules, programming, or other items required to achieve this end result shall be furnished whether or not such item or items are specified herein.

B. The wiring shall be per system manufacturer’s requirements. The cable shall be approved for fire alarm systems, UL rated, and run in conduit. Provide sleeves through walls and floor and seal with fire-stop material.

C. Fire alarm system shall tie into existing campus Siemens Network System. System shall be programmed so that any new or existing device in the building shall alarm the building only. This building is known as “College Complex”. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by The Siemens Industry office in Hayward California. Other suppliers or outlets are not acceptable.

D. Update existing graphic annunciator to include all existing buildings.

E. Fire alarm work must be contracted through Siemens Hayward branch office. Other outlets will not be acceptable.

F. Siemens shall provide one week of factory training for two college B&G employees. This training shall be provided by a factory authorized trainer.

G. The contractor shall at the start of the project determine the state of the existing fire alarm system. At the end of the project the contractor will be responsible for correcting any deficiencies that were not pre-existing. The system shall not be accepted until this has been verified.

1.2 GENERAL REQUIREMENTS

A. Code Requirements: System and all its components to meet requirements for local alarm system of National Fire Protection Association Standard 72 with California Amendments found in CBC, Americans with Disabilities Act (ADA), and Article 760, California Electrical Code, and to be approved by Division of the State Architect for use as school fire alarm system.

B. System Requirements: All of various equipment components to be complete with all appurtenant accessories required to provide specified facilities and perform specified functions throughout presently planned construction and space; and provisions for expanding system to provide same facilities, and perform same functions in all future planned construction, inducing space and mountings in control panels and terminal cabinets.
C. Instructions And Manuals:

1. Equipment supplier of systems to demonstrate operation of system to satisfaction of Owner and furnish Owner three (3) wiring schematics for all items of equipment, installation instructions, and details of all routine maintenance and servicing which must be given system by Owner (refer to Section 26 01 00).

2. Manuals to be provided in substantial fiberboard covers, with title page, list of contents, and conspicuous label on cover and shall be delivered to District. Submit copy to Architect for approval before delivering to Owner.

D. Fire Alarm Certification: Written certification on the form found in NFPA 72 shall be submitted by the Contractor to Architect (with copies to Electrical Engineer and DSA) stating for himself and the equipment manufacturer that component parts are as LISTED AND APPROVED BY State Fire Marshal, that the installation conforms in all respects to requirements as set forth in the California Electrical Code, that acceptance testing has been performed in the presence of the Inspector of Record (IOR), and the certificate signed by the IOR.

E. Installation of the fire alarm system and equipment shall not be started until submittals, including State Fire Marshal listing numbers for each component of the system, have been submitted to and approved by the Architect.

F. Submittals: Furnish catalog data, shop drawings, one-line diagrams, and scaled plan drawings. Building plans shall be 1/8"=1'-0" and site plans shall be no smaller than 1"=40'. Minimum text height shall be 3/32" high. Contractor shall also submit name of firm he proposes to do work under this Section, addresses, phone numbers, and name of firm's contact, for approval. Such firms shall be factory authorized representatives of the equipment specified, who shall furnish all equipment, make all connections to same, and place the systems in operation. Such firms shall have offices and service departments within a 100 mile radius of project and shall have been in business of this type for at least five years. Also, refer to requirement for shop drawings, substitutions, materials, and submittals in Section 26 01 00, Electrical. Two submittal reviews will be made by the Architect's representative. Subsequent reviews will be charged to the Contractor. A rejection of a submittal or review of a partially presented submittal constitutes one submittal review.

1. Fire alarm system design and products have been reviewed and approved by DSA. Alterations to design and/or substitutions proposed by the contractor shall require the following to be included with the fire alarm submittal:

   a. Riser diagram.

   b. Point-to-point diagram.

   c. Mounting detail showing elevations of wall mounted devices.

   d. List of system components, equipment, and devices, including manufacturer's model number(s) and California State Fire Marshal listing numbers.

   e. Copies of manufacturer's specification sheets for equipment and devices indicated.
f. Voltage drop calculations — include the following information for the worst case:

1)  Point-to-Point or ohms law calculations.

2)  Zone used in calculations.

3)  Voltage drop percent (not to exceed manufacturer’s requirement(s). Note: If voltage drop exceeds 10%, indicate manufacturer’s listed operating voltage range(s) for equipment and devices.

g. Battery type(s), amp hours, and load calculations – include the following information:

1)  Normal Operation: 100% of applicable devices for 24 hours = control panel amps plus list of amps per device which draw power from the panel during standby power condition — i.e.:

   a)  Zone modules.
   b)  Detectors.
   c)  Other devices (identify).

   (Note: These specifications require standby power for 72 hours. The specified duration shall be used in calc.s.)

2)  Alarm Condition: 100% of applicable devices for 5 minutes = control panel amps plus list of amps per device which draw power from the panel during alarm condition — i.e.:

   a)  Zone modules.
   b)  Signal modules.
   c)  Detectors.
   d)  Signal devices
   e)  Annunciator.
   f)  Other devices (identify).

3)  Normal Operation + Alarm Condition:

   a)  Total amp hours required.
   b)  Total amp hours provided.

G. Record Drawings: Refer to General Conditions. Final Inspection will not be made until drawings are received and approved. Record Drawings shall include "As-Built" one-line and wiring diagrams, with terminations identified, wire color coding schedule, pullbox locations, and conduit routing plans.

H. Guarantee:

1. One firm to assume full responsibility for performance on all work of this section. Guarantee all equipment against defects in material and workmanship for three (3) years, and provide on-the-premises service during normal working hours for one year, at no cost to purchaser if trouble is not caused by misuse, abuse, or accident, or at current labor rates if so caused. Provide manufacturer's written three-year
guarantee for equipment and parts.

2. Service shall normally be available within 24 hours from service department of authorized distributor of manufacturer by factory trained servicemen.

3. On-the-premises service at other than normal working hours to also be available, but labor charges for such calls to be paid by purchaser at current labor rates.

I. Product Delivery, Storage and Handling:

1. Ship equipment in original packages to prevent damage or entry of foreign matter. All handling shall be in accordance with manufacturer's recommendations. Provide protective covering during construction.

2. Replace, at no expense to Owner, equipment or material damaged during storage or installation as directed by the Architect.

PART 2 - DETAIL REQUIREMENTS AND PRODUCTS

2.1 SYSTEM OPERATION

A. Activation of any manual station, water flow switch, or automatic detector shall cause the sounding of all signals. In addition to sounding local alarm signals, operation of manual stations, water flow switch, or automatic detectors shall activate a relay for telephone leased line reporting to remote location via digital communicator. Digital communicator shall report alarm and trouble conditions. Telephone company leased lines shall be arranged by the Owner.

B. The system shall be electrically supervised against open circuits and grounds on the wiring to the alarm-initiating devices. An open or ground in the system shall cause a trouble signal to sound continuously until the system is restored to normal or until the signal is silenced by means of a cut-off switch. When the cut-off switch is thrown to the “off” position, a white pilot light shall be illuminated to show that the trouble signal is off. When the system is restored to normal operation, the trouble signal shall sound again and shall be silenced only by restoring the cut-off switch to its normal position, thereby also extinguishing the pilot light. Open and grounded circuits in the system shall not cause the sounding of false alarms. System shall be capable of initiating fire drill signal from master location. Fire drill signal shall not activate relay for remote reporting facilities.

2.2 STANDARD PRODUCTS

A. Equipment and accessories furnished under the terms of these specifications shall be the standard products of a single manufacturer. All equipment shall be listed by U.L. and State Fire Marshal. Specifications are based on District standards.

B. Manual Stations: Administrative manual and manual alarm-initiating devices shall be for semi-flush mounting, double action, open circuit manual stations located as shown on plans with addressable module. Each manual station shall have its own address.

C. Fire Alarm Control Panel: Existing control unit is Siemens MXL. Opening main door shall expose all components for inspection or adjustment without further dismantling of the cabinet, control units, or wiring. All electrical components shall be modular.
1. Provide audible trouble signal.

2. Main source system shall operate on a 120 volt, 60-cycle, AC power unit.

3. Auxiliary Source: Batteries shall be provided to operate the system under supervisory conditions for up to 72 hours after a power failure. Provide separate enclosure similar to control unit construction, if required.

4. Control panel shall provide addressable and hardwired monitoring and control. The unit shall be programmable to meet user needs and code requirements. A backlit 80 character liquid crystal display shall be provided to display condition status.

5. Control panel shall include modules for addressable initiation loops as required by the Drawings with a minimum of (2) spare addressable loops.

6. Control Panel shall include modules for alarm indicating appliance circuits necessary for devices provided in this project plus two (2) spare circuits and space for two (2) future circuits. Alarm circuits shall be field programmable to provide steady or “temporal pattern” alarm tones and it shall be possible to have both occur simultaneously on different circuits.

D. Heat Detectors (Addressable): Shall be rate-of-rise type with test switch and tamperproof base.

E. Duct Detectors: Shall be addressable photoelectric or ionization type. Coordinate requirements with mechanical plans.

F. Smoke Detectors: Shall be addressable photoelectric type with test switch, LED status indicator, and tamperproof locking base.

G. Addressable Modules: Shall provide an address for a group of normally open initiating devices.
   2. Output Module: TRI-R.

H. Audible/Visual Devices: All fire alarm devices shall be U.L. listed and meet ADA requirements. All devices shall have a red finish. All fire alarm audible devices shall have the same basic sound and pattern and shall be ANSI S3.41.
   1. Fire Alarm Horns: Shall be semi-flush mounted with wall trim plate. Horns installed at exterior locations shall be provided with cast weatherproof boxes. All exposed parts of horn, boxes, and plates shall be finished with red enamel. Horns shall be Wheelock. Set horns at 99dBA.
   2. Combination Horn/Visual Alarm Indicating Devices: Shall be semi-flush mounted, high intensity Xenon flasher type with candela (cd) output specified on drawings. Wheelock as shown on plans. Set horn dBA at 99 and minihorn dBA at 90.
   3. Visual Fire Alarm Indicating Devices: Shall be semi-flush mounted, high intensity
Xenon flasher type with candela (cd) output specified on drawings. Wheelock as shown on plans.

I. Digital Communicator: Existing.

J. Signal Extender Panel: Shall provide a minimum of four notification appliance circuits. Wheelock PS-8. Provide with 7.0Ah batteries.

K. Electromagnetic door holders shall be recessed.

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. System shall be complete and operational in every respect.

B. Provide certification of testing by local fire district.

C. Label all zone cables at devices and junction boxes using E-Z Marker labels. Label all conduits leaving the fire alarm equipment in Administration Building with zone and circuit numbers with black ink. Label inside cover of device with zone and circuit number.

D. Provide red laminate labels engraved with white letters indicating type of fire alarm main equipment i.e. "FATC-T", "RPS-T", etc.

E. Fire alarm contractor shall provide services for alerting service technicians 24 hours-7 days a week-365 days of the year.

F. Fire alarm contractor shall have a minimum of five years experience in installing fire alarm systems and shall show evidence of experience.

3.2 TEST AND REPORTS

A. System test shall be performed only by an individual who has attended a manufacturer's training school for installation and testing the system as described above and shall provide evidence of certification from manufacturer. Testing of the system shall be performed with the test instruments as required by the manufacturer; testing by means other than the manufacturer's procedures will not be acceptable unless agreed to by the Owner, specifying engineer, and the manufacturer.

B. Upon completion of the installation to the existing fire alarm system, a satisfactory test of the entire system shall be made in the presence of the enforcing agencies.

Reports Shall Include, But Not Be Limited To:

1. A complete list of equipment/devices installed.

2. Indications that all equipment/devices are properly installed and functions and conforms with these Specifications.

3. Test of all individual zones and devices.

4. List of serial numbers, locations by zone and device number, and model number.
for each detector installed.

5. List method of testing and smoke detectors.

6. Technician's name, company and date.

7. Complete Record Drawings of wiring and conduits.

8. Detailed catalog data on all installed components.

9. Copy of the test reports described above.

10. Sixty days prior to expiration of warranty, Contractor shall retest entire system as described above, and submit a test report of findings. All items covered by warranty shall be corrected immediately. Warranty remains in effect until 100% of defective items are corrected by Contractor.

11. Upon completion of the installation of fire alarm equipment, the electrical contractor shall provide to the architect, a signed written statement substantially in the form as follows:

THE UNDERSIGNED HAVING BEEN ENGAGED AS THE ELECTRICAL CONTRACTOR ON (Project Name) CONFIRMS THAT THE FIRE ALARM EQUIPMENT WAS INSTALLED IN ACCORDANCE WITH WIRING DIAGRAMS, INSTRUCTIONS AND DIRECTIONS PROVIDED TO US BY THE MANUFACTURER.

END OF SECTION