SECTION 10 11 16

VISUAL DISPLAY BOARDS AND PANELS

PART 1 – GENERAL

1.01 SUMMARY

A. Provisions of Division 01 apply to this section.

B. Section Includes:

1. Markerboards, trim and rails where shown and of size indicated on Drawings.

C. Related Sections:
1. Section 09 22 16: Non-structural Metal Framing

2. Section 09 90 00: Painting.

1.02 SUBMITTALS

A. Shop Drawings: Shop Drawings to indicate gages, profiles, sections of materials, details of construction, hardware, methods of attachment and/or anchoring, as applicable for specified materials.

B. Samples: Submit the following:

1. 3 inch x 5 inch markerboard Samples, provide manufacturer's full range of colors.

C. Product Data: Submit manufacturer's technical data, product specifications, installation instructions, and other pertinent information as applicable for each product or material specified.

D. Test Reports: Submit certified laboratory test reports as applicable to indicate compliance with specified requirements.

1.03 QUALITY ASSURANCE

A. Manufacturer shall have been regularly engaged in the business of manufacturing markerboards for at least 5 years.

B. Comply with requirements and recommendations of applicable portions of Porcelain Enamel Institute - PEI 2.

1.04 PRODUCT HANDLING

A. Deliver materials to the Project site with manufacturer's labels intact and legible.

B. Provide all means necessary to protect markerboards before, during and after installation.

1.05 JOB CONDITIONS

4/26/2011 4.2

A. Sequencing, Scheduling:

1. Coordinate with related Work of other sections including backing in metal stud partitions and gypsum board.

2. Do not install markerboards until paint is installed to surfaces concealed behind them.

1.06 SPECIAL PROJECT WARRANTY

A. Manufacturer shall provide a 50 year material warranty from the date of final acceptance

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS (MARKERBOARDS)

A. Alliance Wall Corporation

B. Greensteel, Inc., a division of Polyvision Corporation.

C. Nelson – Adams Company.

D. Tri-Best

2.02 SYSTEM PERFORMANCE

A. System shall be comprised of factory assembled markerboards, in configurations and sizes indicated on the Drawings or as specified herein.

B. Laminations of panel components shall be by face sheet manufacturer.

2.03 MATERIALS

A. Markerboards

2. Markerboard: 24 ga. porcelain enamel steel laminated to 7/8 inch thick honeycomb core with moisture barrier backing sheet of 0.015 aluminum and NACO C-12 Trim at perimeter and nylon guides at guide channel edge.

a. Markerboard facing color: #6100H White, unless otherwise indicated on Drawings.

b. Pulls: Ives No. 230, or equal. Provide 2 recessed pulls per panel at jambs.

3. Map Rail, surface mounted 2"width: NACO MR-3, with insert and end stops, or equal.

a. Combination Maphook/Clip: NACO H-2, or equal. Provide 2 for each 8 feet of map rail or fraction thereof.

b. Roller Map Bracket: NACO RB-2, or equal. Provide 2 for each 8 feet of map rail or fraction thereof.

4. Pentray: NACO modified CRC-2B Chalktray, or equal.

5. Provide tackboard units with same components where shown on the drawings.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install markerboard, trim, map rail and marker tray in accordance with manufacturer's directions and reviewed Shop Drawings. Fasteners for assembly of trim and frame units shall be truss head aluminum or stainless steel self-tapping screws with double cadmium-plated finish.

B. Install panels after finish painting of wall surfaces has been completed and paint is cured. Install panels level, plumb and neatly assembled. Before Substantial Completion, trim shall be completely cleaned of dirt, finger-marks, or other foreign material.

C. Install panel guides, spacers, and panels at media wall cabinets as indicated.

3.02 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.03 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 10 21 13

PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Solid plastic toilet compartments.

B. Urinal and Vestibule screens.

1.02 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Concealed steel support members.

B. Section 09 21 16 - Gypsum Board Assemblies

C. Section 09 22 16 - Non-structural Metal Framing

1.03 REFERENCE STANDARDS

A. ASTM E84-01 Standard Test Method for Surface Burning Characteristics of Building Materials

B. ASTM D2794 Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

C. ASTM D2197 Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion

D. ASTM D6578 Standard Practice for Determination of Graffiti Resistance

1.04 PERFORMANCE REQUIREMENTS

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

B. Graffiti Resistance: Partition material shall have graffiti removal characteristics in accordance with ASTM D6578.

C. Scratch Resistance: Partition material shall have scratch resistance (maximum load value shall exceed 20 lbs) in accordance with ASTM D2197.

D. Impact Resistance: Partition material shall have impact resistance in excess of 30 inch-pounds when tested in accordance with ASTM D2794.

E. Fire Resistance: Smoke Developed: Less than 450; Flame Spread: Less than 75.

1.05 SUBMITTALS

A. See Section 01 33 00 - Administrative Requirements, 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.

PART 2 PRODUCTS (Refer also to Section 09 0000)

2.01 MANUFACTURERS

A. Plastic Toilet Compartments:
   1. Bobrick: Product (Basis of Design): Sierra Series 1090 Solid Color Reinforced Composite Toilet Partitions
   2. Scranton

3. Substitutions: Section 01 63 00 – Product Substitution Procedures.

2.02 COMPONENTS

A. Toilet Compartments: Solid reinforced composite panels, doors, and pilasters, composed of dyes, organic fibrous material and polycarbonate/phenolic resins, shall be floor-to-ceiling mounted..

B. Door and Panel Dimensions:
   1. Thickness: 3/4 inch with edges radiused.
   2. Door Width: 24 inch.
   3. Door Width for Handicapped Use: 36 inch, out-swinging.
   4. Height: 58 inch.

C. Urinal Screens: Wall mounted with two panel brackets, and floor-to-ceiling vertical upright consisting of pilaster anchored to floor and ceiling.

2.03 ACCESSORIES

A. Stile Shoes: Stainless steel with satin finish, 4 in high, concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

C. Wall Brackets: Continuous type, polished stainless steel.

D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.

E. Hardware: Polished stainless steel with satin finish
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door. Hinges shall be attached to door and stile by theft-resistant, pin-in-head Torx stainless steel machine screws in factory-installed threaded brass inserts.
   2. Door Latch: 14 gauge slide type with exterior emergency access feature. Latch shall require less than 5 lbs. to open.
   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.
   5. Provide door pull for outswinging 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 stainless steel angle with ¾" stainless steel tamper resistant torx head screws.

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.

END OF SECTION

SECTION 10 22 26

ACOUSTICAL WALL

PART 1 – GENERAL

1.01 Summary

A. Section Includes: Automatic Vertically Folding Acoustical Wall(s) as shown on the architectural drawings. All necessary hardware, seals, lifting machinery, electrical controls are included.

B. Related Sections

1. Section 05 12 00 - Structural Steel Framing

2. Section 26 05 03 - Equipment Wiring Connections

1.02 References

A. ASTM E90-90 Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

B. ASTM E413-87 Classification for Rating Sound Insulation

C. ASTM E557-77 Standard Practice for Architectural Application and Insulation of Operable Partitions

1.03 System Description

A. Vertically Folding Acoustical Wall performance requirements:

1. Automatic Vertically Folding Acoustical Wall (from here on called Operable Wall) shall refer specifically to acoustical partitions that, when in the down position (closed) are hard, rigid, flat, plumb walls, made of a grid of rectangular acoustical panels, and when are lifted (opened), fold upward (vertically) without the use of any manual labor, in a manner similar to an accordion, into a pocket in the ceiling, between roof joists, or up between built in bulkheads. In the down (closed) position, the wall shall be comprised of two vertical planes of acoustical panels, separated by an acoustical air space.

   The operable wall shall open and close in a manner similar to an accordion, in that all wall panels fold and unfold at the exact same time, at the exact same rate. Walls that rely on the sequential folding of acoustical panels or acoustical panel sets are not acceptable.

2. There are two types of drive systems acceptable for the operable wall at the Contractor's opinion:

   a. Compact Drive System:
   The motor assembly is mounted directly above the centre line of the operable wall. Support steel is only required at one location. Used for walls up to 30'-0" (9145 mm) finished ceiling

b. Remote Drive System
The motor/shaft/drum assembly is off-set from the centre line of the operable wall. The required distance depends upon the height of the wall. Support steel is required at two locations. Used for walls up to a maximum 30'-0" (9145 mm) finished ceiling height where there are space restrictions.

3. The operable wall shall be opened and closed using two spring return, 3 position key switches wired in series. Simultaneously turning the keys from the "off" position shall cause the wall to move in the designated direction "up" or "down". When hand pressure is removed, the wall shall immediately stop. The operable wall shall stop in a quick and positive fashion without coasting. As a normal part of the operation, it shall be possible to partially open (or close) the wall, stop it and then reverse the operation. There shall be 2 key switches per operable wall, located on opposite sides of the wall at opposite ends of the wall, wired in series.

4. From a fully open position, the wall shall be able to go through its entire cycle of closing and/or opening without any manual intervention.

5. When the operable wall is being lowered (closed) it shall come automatically to rest once it has reached the fully down (closed) position. When the operable wall is being lifted (opened) it shall come automatically to rest once it has reached the fully up (open) position.

6. The operable wall shall automatically and acoustically seal against the floor without the need for any manual intervention. The floor seals shall leave a joint between the floor and the bottom acoustical panels of not more than approximately 2" (51 mm).

   The operable wall shall automatically and acoustically seal against the two end walls without the need for any manual intervention. The end seals shall act in such a way as not to come into contact with the end walls while the operable wall is in motion. The end seals shall leave a joint between the acoustical panels and the end walls of no more than approximately 1" (25 mm). Seals that rub or brush against the end walls are not acceptable. Once the wall reaches the full down position, the end seals shall activate automatically. The key switch must be held for the duration of the operation.

   The operable wall shall automatically and acoustically seal against the ceiling without any manual intervention. The top seals shall leave a joint between the top acoustical panels and the ceiling of the pocket of not more than approximately 2" (51 mm).

   The operable wall shall open and close at a constant nominal speed of approximately 5 to 10 vertical feet per minute (1.5 to 3 meters per minute).
   When the operable wall is being lowered (closed), it shall stop if the leading (bottom) edge comes into firm contact with any object between it and the floor. The regular operation of the wall shall resume once the key switch has been released and the direction of the wall has been reversed and the obstruction removed.

7. The operable wall shall be visibly flat and rigid in the down (closed) position.
   There shall be no exposed hinges, brackets, screws, and no part of the mechanical system shall be visible when the operable wall is in the down (closed) position.
   All of the panel edges shall be right angled, with a minimum radius not more than 1/16" (1.6 mm).

All of the panels shall be rectangular, nominally of the same size, unless requested otherwise by the architect.

Joints between panel, vertical and horizontal, shall be no more than approximately ½" (12.7 mm) wide.

8. For operable walls using the Compact Drive System or the Remote Drive System, the operable wall shall stack in the up (open) position into a space no greater than 65" (1.65 mm) wide. The operable wall shall have a stacking height ratio in the range of 1:5 to 1:10, depending on the height of the wall.

9. Each acoustical panel shall be individually removable using only a screw driver. No special tools or equipment shall be required. The removal of a single acoustical panel shall not affect, dislocate or cause the removal of any adjacent panels or other acoustical panels.
The operable wall shall be mechanically operable with a few of the acoustical panels removed from one, or both sides of the operable wall.

10. The operable wall shall not weigh more than 8 lbs per square foot (39.1 kg per square meter), not including the lifting equipment and the architectural finish on the acoustical panels.

11. A completely functioning operable wall, tested in full accordance and compliance with ASTM E90-90 shall achieve a Laboratory Sound Transmission Class all (STC) rating of not less than 51.

12. The operable wall shall be designed to have a design life of at least 10,000 complete closed to opened to closed cycles.

1.06. Quality Assurance

A. Qualifications

1. The products herein specified established the standard of quality for the Automatic Vertically Folding Acoustical Walls based on Skyfold® Classic™ Custom powerlift partitions by Railtech Ltd. of Baie d'Urfe (Montréal), Québec, Canada. Proposals for substitution of products or techniques not conforming to these specifications must be submitted at least ten (10) days prior to bidding. Independent test reports which meet the requirements and design specified herein must be submitted to obtain approval.

2. Installer qualifications: All work and materials specified herein, shall be installed only by qualified representatives and/or installers and/or distributors of the manufacturer, according to the manufacturers written instructions.

3. Manufacturer's qualifications:
The operable wall must be manufactured by a certified ISO-9001-2000 company or an equivalent quality control system.

1.04 Submittals

A. Submit manufacturers' technical data for each type of operable wall specified herein. Comply with Section 01 33 00, Submittal Procedures.

B. Submit shop drawings showing complete layout of operable wall system based on field verified dimensions. The drawings shall include dimensional relationship to adjoining work. Include details indicating materials, finishes, tolerances, and methods of attachment to building steel and electrical requirements.

C. Submit certified test reports evidencing compliance to acoustical STC requirements as specified in paragraph 1.3.2.20.

1.07 Site Conditions

A. The floor underneath the operable wall along its axis, shall be flat to within +/- ¼" (6 mm) over the entire length of an operable wall. The peak to valley undulation of +/- ¼" (6 mm) shall not be closer together than 24" (610 mm) and a peak to valley undulation of +/- 1/8" (3 mm) shall not be closer than 12" (305 mm).

B. Support steel above the operable wall along its axis shall be parallel to the floor within +/- ½" (12.7 mm) for the entire length of the operable wall. This includes loaded deflection. The beam must also be parallel to the centre line of the wall within ± 1/8" (3 mm), left to right.

C. The fixed walls at either end of the operable wall shall be within +1/4" (6 mm)-0", from plumb vertical. The fixed walls at either end of the operable wall shall be flat to within +0", -1/4" (6 mm).

1.05 Warranty

A. The operable wall shall be warranted free from defects in material and workmanship for a period of two years or five thousand cycles and the parts only will be free from defect for a period of ten years or five thousand cycles, whichever occurs first from date of shipment.

B. Parts and labor required to maintain the operable wall and part subject to normal wear and tear are not covered under the warranty and are the owner's responsibility. (Refer to Maintenance Program).

PART 2 – PRODUCTS

2.01. Acceptable Manufacturers

A. Skyfold® Classic™ Custom powerlift partitions as manufactured by Railtech Ltd. of Baie d'Urfe (Montréal), Québec, Canada and Railtech Composites Inc., Plattsburgh, New York, USA (514) 457-4767.
E-mail: skyfold@skyfold.com
Web-site: www.skyfold.com

B. Alternate systems can be used if they meet or exceed the performance criteria outlined in Part 1 - General above and if they are approved according to the provisions of 1.6 A 1 above.

2.02 Materials

A. Acoustical Panels

1. Acoustical panels shall be faced with steel that is compatible with a wide variety of architectural finishes such as paint, vinyl, specialty metals, wood veneer, etc.

2. Acoustical panels, together with all of the sound insulation, shall be, as much as possible, made of non-combustible or fire-treated materials.

3. Acoustical panels shall be fabricated to be as stiff as possible in order to satisfy the rigid criteria when the operable wall is down (closed) and to ensure that there is no interference between panels when the wall is in motion.

4. Acoustical panels shall be architecturally flat with no bowing, oil canning, warping, waviness or any other surface deformation and discontinuity.

5. Acoustical panels shall have the finish of the architect's choice, provided that the finish has been approved by the operable wall manufacturer to ensure compatibility with the wall panels. The following criteria must be met:
   Maximum weight of material: .111 lbs/ft²
   Maximum thickness of material: 1/8"
   No brittle materials.
   Typically our finishes are railroaded onto our panels. Applied horizontally along the panel length.

B. Folding Mechanism

1. The hanging, folding and extension mechanism shall be, as much as possible, made from structural grade aluminum extrusions and structural shapes, in order to minimize the weight of the system.

2. All wear surfaces, such as bushings, spacers, pins, discs, bearings, and sleeves shall be designed to function quietly and with minimum wear, over the 10,000 cycle design life of the operable wall.

3. The hangers, which fasten the lifting mechanism to the support steel, shall be fabricated from steel and shall be welded or bolted to the support steel supplied by others.

C. Lifting Equipment

1. The lifting equipment shall be sized properly so that it can open and close the wall effectively over the 10,000 cycle design life of the wall, at the minimum design speed specified in point 1.3.2.8.

2. The lifting mechanism shall be designed to function as smoothly, quietly and safely as possible. Wherever possible, ball bearings shall be used instead of bushings and wear surfaces. In no circumstance shall chain or belt drive systems be acceptable.

3. There shall be a wire rope cable for every set of lifting mechanisms. This cable shall be of 6 x 31 construction aircraft cable and shall be made of galvanized steel. The diameter of the cables shall be sized so that they shall be able to hold the entire weight of the wall, with the appropriate safety factor.

4. For the remote drive system, each wire rope cable shall wind and unwind on its own cable drum. The cable drums shall be grooved to accept a single layer of cable and shall have a minimum pitch diameter of 20 times the cable diameter. Length of drums shall be sufficient to accommodate 3 cable safety wraps. Cable drums shall be keyed to the line

shaft. For the micro and compact drive systems, the cable wraps on yoyo drums with 2 safety wraps and multiple layers of cable.

5. The line shaft, sized to deliver the required torque with minimum deflection, shall support and rotate the cable drums.

6. Pillow block bearings (for the remote drive system), of appropriate size, support the line shaft and shall be located immediately on either side of each cable drum. Flange bearings shall be used for the compact drive system, located immediately on both sides of the drum assembly.

7. For the remote drive system, the line shaft shall be connected directly to the power drive through properly sized, load rated couplings, keyed to the line shaft.

8. The power drive shall be sized to deliver sufficient amount of torque to safely and effectively raise and lower the operable wall over its design life.

9. The lifting equipment shall use the latest in industry standards in thermal protection, overload protection, quick acting fuses, etc., in order to ensure the safety and reliability of the system.

D. Safety Equipment

1. The operable wall shall employ an electromagnetic type of brake which shall activate firmly, without hesitation, when power is lost to the system. This brake shall have a minimum retarding torque rating equal to 200% of the power drive full load torque. A manual break release lever is supplied on the motor.

2. The operable wall shall employ a dynamic brake, distinct and separate from the brake in 2.2.4.1, in order to lower the wall at a controlled speed of no more than approximately 150% of the normal down speed, in the case of a catastrophic failure in the power train. Alternately, the operable wall shall employ a brake, distinct and separate from the brake in 2.2.4.1, in order to completely halt the downward motion of the wall in the case of a catastrophic failure in the power train.

3. The operable wall shall employ electrical or other limit switches in order to stop the wall at its up and down travel limits.

4. The operable wall shall employ an over torque detector in order to sense a jam in the system and to act as an over travel limit in the up direction should the primary limit switch fail to act in 1.3.2.4. This over torque sensor shall be mechanical, using the motor's torque arm in its over torque detection.

5. The entire length of the bottom edge of the operable wall shall be equipped with a continuous pressure sensing strip which shall cut power to the lifting equipment and shall activate the brake outlined in 2.2.4.1, if the sensing edge comes in firm contact with an object, before the wall is in the full down (closed) position. The power shall remain cut to the lifting equipment until the key switch has been released or the direction of the wall has been reversed and the obstruction is removed.

2.03.Fabrication

A. General

1. Factory assemble all components, assemblies and systems into the largest possible assemblies in order to minimize the amount of assembly on site.

2.04 Finishes

A. Refer to Section 00 90 00.

PART 3 – EXECUTION

3.01 Inspection

A. Inspect the relevant aspects of the site such as the evenness of the floor, walls, structural steel, etc., and ensure that these are within the tolerances stated in Part – 1 of this specification.

B. Confirm in writing to the General Contractor or contract manager any deviations from these tolerances. Do not proceed until these conditions are made good.

C. Carry out all appropriate field measurements before manufacturing any components or assemblies.

3.02 Installation

A. Install operable walls in accordance with the manufacturer's printed instructions.

B. The operable wall supplier shall not deliver or install this product until the General Contractor can ensure in writing safe storage and protection for the wall for the duration of the project.

3.03 Adjusting and Cleaning

A. Adjust and fine-tune the operable walls to ensure that all seals are operating and sealing properly and that the walls are in correct and smooth operation.

B. Clean up any dirt, oil, grime, etc., that may have found its way onto the acoustical panels. Leave the wall in a state of architectural cleanliness.

END OF SECTION

SECTION 10 22 26.33

FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Acoustic operable panel partition.

B. Ceiling track, ceiling guards, and operating hardware.

1.02 RELATED REQUIREMENTS

A. Section 05 50 00: Overhead track structural support framing.

B. Section 07 90 05 - Joint Sealers: Acoustical sealant.

C. Section 08 71 00 - Door Hardware: Lock cylinders for panels.

D. Section 09 77 23 – Fabric-Wrapped Panels: Product requirements for fabric finish for installation by this section.

1.03 REFERENCE STANDARDS

A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2008.

B. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2004.

C. ASTM E 413 - Classification for Rating Sound Insulation; 2004.

D. ASTM E 557 - Standard Guide for The Installation of Operable Partitions; 2000 (Reapproved 2006).

E. ASTM E 596 - Standard Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures; 1996 (Reapproved 2002).

F. ASTM F 793 - Standard Classification of Wallcovering by Use Characteristics; 2007.

1.04 SUBMITTALS

A. See Section 01 33 00 -Submittal Procedures.

B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, and colors and finishes available.

C. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, and stacking depth.

D. Samples for Selection: Submit two samples of full manufacturer's color range for selection of colors.

E. Samples for Review: Submit two samples of surface finish, 12 x 12 inches size, illustrating quality.

F. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.

G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware

finish.

1.05 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of this section with minimum 5 years of experience.

C. Warranty: Provide written warranty by manufacturer of operable partitions for repair and replacement of any component defects for a period of two years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Design is based on Modernfold; Product Acousticseal 932.

B. Other Acceptable Manufacturers:
   1. Hufcor, Inc; Product: Series 600 www.hufcor.com.
   2. Panelfold, Inc; Product: Moduflex 620 www.panelfold.com.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Operable Panel Partition: Center opening; paired panels; center stacking; manually-operated.
   1. Panel Finish: Fabric panel (FP-1) as specified in 09 00 00 and 09 77 23.
   2. Noise Reduction Coefficient (NRC): ASTM E 596, NRC of 0.55 minimum.
   3. Sound Transmission Class (STC): 43-44 calculated in accordance with ASTM E 413, based on tests conducted in accordance with ASTM E 90, on panel size of 100 sq ft.
   4. Surface Burning Characteristics of Panel Finish: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84.

B. Panel Construction:

C. Core: 16 gage formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, internally reinforced at suspension points, with acoustical insulation fill.
   1. Thickness with Finish: 3 inches.
   2. Factory applied surface finish.
   3. Trim: Trimless.
   4. Hinges: Continuous piano type, 18 gage stainless steel.
   5. Panel to Panel Seals: Grooved and gasketed astragals; continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.

D. Track: Formed steel; 1-1/4 x 1-1/4 inches size; thickness and profile designed to support loads, steel sub-channel, track connectors and track switches.

E. Carriers: Nylon wheels on trolley carrier at top of every second panel, sized to carry imposed loads, with threaded pendant bolt for vertical adjustment.

F. Acoustic Seals: Flexible acoustic seals at jambs, meeting mullions, ceilings, retractable floor and ceiling seals, and above track to structure acoustic seal.

G. Fabric Panel: Polyethylene yarn fabric with paper backing adhered to ¼" fiber reinforced cement board. Color from manufacturer's standard selection.

H. Acoustic Sealant: Specified in Section 07 90 05.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated on shop drawings.

B. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.

C. Verify wall plumbness of 1/8 inch in 10 feet, non-cumulative.

3.02 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E 557.

B. Fit and align partition assembly and pocket doors level and plumb.

C. Lubricate moving components.

D. Apply acoustic sealant to achieve required acoustic performance.

3.03 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

C. Adjust partition assembly to achieve lightproof seal.

3.04 CLOSEOUT ACTIVITIES

A. Demonstrate operation of partition.

END OF SECTION

SECTION 10 44 00

FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the following:
   1. Fire extinguishers and mounting brackets.
   2. Recessed Cabinets

1.02 REFERENCES

A. CFC - California Fire Code 2007, Section 906.

B. Title 19, CCR, California Code of Regulations, Public Safety, State Fire Marshal Regulations, Division 01, Chapter 3, Article 5.

C. UL Underwriters Laboratories Inc. Fire Protection Equipment.

1.03 SUBMITTALS

A. Product data showing physical dimensions, operational features, color and finish, anchorage details, rough-in measurements, location and details.

B. Manufacturer's installation instructions.

C. Material Samples: Submit cabinet color and finish samples for selection by Architect.

D. Material Safety Data Sheet: Provide an MSDS sheet with every shipment as set forth in California Labor Code, Section 6390.

E. Manufacturer's operation and maintenance data. Include test, refill or recharge schedules, procedures and re-certification including requirements applicable to Work.

1.04 QUALITY ASSURANCE

A. Conform to Title 19-CCR, Division 01 Chapters 1 and 3, requirements for extinguishers.

B. Fire extinguishers shall have current certification tag attached.

C. Fire extinguishers must be UL certified.

1.05 WARRANTY

A. Manufacturer shall install a 5 year material warranty from the date of final acceptance.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install extinguishers when ambient temperatures may cause freezing.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Ansul®/Sentry 10 Series
   2. Amerex Corporation, Los Angeles, CA, UL No. EX 2764.
   3. Badger Fire Protection, Charlottesville, VA.
   4. General Fire Equipment, Spokane, WA.
   5. Potter-Roemer, Inc., Santa Ana, CA, UL No. EX 3699.
   6. Larsen's Manufacturing

B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.02 EXTINGUISHERS

A. Fire Extinguisher Type: Provide a legally appropriate rechargeable dry-chemical fire extinguisher for every fire extinguisher cabinet as shown on the drawings and as otherwise indicated.
   1. Type ABC multi-purpose dry chemical with UL rating Model Sentry SY1014 4A:60B:C, 10 lb. size, also with red glossy polyester coated steel cylinder, pressure gage, hose and horn. Maximum Height: 21-3/4". Maximum Cylinder Diameter: 8-1/2".
   2 Manufacturer Identification/Information: Manufacturer's name, date manufactured, model number, U.L. approved seal and/or number, contents operating instructions, etc. shall be identified on the fire extinguisher.
   3. Warning and First Aid Label: Fire extinguisher must indicate all standard warnings concerning breathing, eyes, skin and ingestion. Provide emergency and first aid procedures.
   4 Property Identification: Label affixed at front of unit, size 2x4-inch, shall read "PROPERTY OF RIVERSIDE COUNTY".
   5 Repair Parts: The manufacturer and/or their representative shall maintain within the greater Riverside/San Bernardino Area an adequate stock of replacement parts, available for immediate delivery.

2.03 CABINETS

A. Model: Potter-Roemer- ALTA or equal.
   1. Size: To accommodate extinguisher specified herein.
   2. Mounting Style: Recessed, bottom of cabinet at 32 inches above finish floor, 4 inches maximum projection.
      a. Steel: Cold rolled steel with electrostatically applied thermally fused coating, color as selected by the Architect from manufacturer's standard list.

3. Door Style: Center break glass with lock.
4. Glazing: clear tempered safety glass.
5. Lettering
   a. Vertical: Red.

B. Latching and locking hardware shall be operable with a single effort by lever type hardware, or other hardware designed so as to not require grasping the opening hardware and not require a force greater than 5 lbs to open.
1. Force required to activate controls shall not exceed 5 lbs.
2. Be recessed or semi-recessed in order not to protrude more than 4 inches from face of wall.
3. Mount between 15-48 inches AFF for forward approach. Refer also to drawings.

2.04 FABRICATION OF CABINETS

A. Form body of cabinet with tight inside corners and seams.

B. Pre-drill holes for anchorage.

C. Form perimeter trim and door stiles by welding, filling and grinding smooth.

D. Hinge doors for 180 degree opening with continuous piano hinge.

E. Glaze doors with resilient channel gasket glazing.

F. Pull Handle: U-pull type with roller catch, 5 pounds maximum operating force.

2.05 MOUNTING BRACKETS

A. Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish.

B. Provide brackets for extinguishers not located in cabinets sized for unit.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify rough openings for cabinet and mounting brackets are correctly sized and located.

B. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Install cabinets plumb and level in wall openings. Locate cabinets to a height to yield a maximum of 48 inches from finish floor to top of handle of fire extinguisher unit. Locate cabinet within five feet of the main egress door.

B. Mount brackets to a height to yield 48 inches maximum to handle of fire extinguisher where no cabinets are indicated. Coordinate suitable backing at the mounting bracket location.

C. Secure rigidly in place.

3.03 INSPECTION BY REGULATORY AGENCIES

A. Schedule inspection with agencies and Owner.

B. Furnish approval certificates issued by jurisdictional authorities.

END OF SECTION

SECTION 12 22 16

ROLLER SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manually operated sunscreen roller shades.

B. Motorized double-roller sunscreen and room-darkening shades.

C. Master control system for shade operation.

1.2 RELATED SECTIONS

A. Section 09 21 16 - Gypsum Board Assemblies: Coordination with gypsum board assemblies for installation of shade pockets, closures and related accessories.

B. Section 09 51 00 - Acoustical Ceilings: Coordination with acoustical ceiling systems for installation of shade pockets, closures and related accessories.

C. Division 26 - Electrical: Electric service for motor controls.

1.3 REFERENCES

A. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. NFPA 70 - National Electrical Code.

C. NFPA 701-99 - Fire Tests for Flame-Resistant Textiles and Films.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Submit Environmental Certification and Third Party Evaluation per Section 1.5 Qualifications.

C. Product Data: Manufacturer's data sheets on each product to be used, including: Preparation instructions and recommendations. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions. Storage and handling requirements and recommendations. Mounting details and installation methods. Typical wiring diagrams including integration of motor controllers with building management system, audiovisual and lighting control systems as applicable.

D. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.
Prepare shop drawings on Autocad or Microstation format. Indicate handedness of chain pulls for manual shades and motor locations for motorized shades.

E. Window Treatment Schedule: For all roller shades use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

F. Selection Samples: For each finish product specified, one set of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns. Submittal of shadecloth only, without manufacturer and hardware product data, shall not be acceptable.

G. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shadecloth sample and aluminum finish sample as selected. Mark face of material to indicate interior faces.

H. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.

B. Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.

C. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

D. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.

E. Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

F. Shade cloth to "pass" indoor Air Quality / VOC Testing as per ASTM D 5116-97 and ASTM D 6670-01, USEPA – ETV (U.S. Environmental Protection Agency's Environmental Technology Verification Protocol).

G. Environmental Certification: Submit written certification from the manufacturer, including third party evaluation, recycling characteristics, and perpetual use certification as specified below. Initial submittals, which do not include the Environmental Certification, below will be rejected. Materials that are simply 'PVC free' without identifying their inputs shall not qualify as meeting the intent of this specification and shall be rejected.

H. Third Party Evaluation: Provide documentation stating the shade cloth has undergone third party evaluation for all chemical inputs, down to a scale of 100 parts per million, that have been evaluated for human and environmental safety. Identify any and all inputs, which are known to be carcinogenic, mutagenic, teratogenic, reproductively toxic, or endocrine disrupting. Also identify items that are toxic to aquatic systems, contain heavy metals, or organohalogens. The material shall contain no inputs that are known problems to human or environmental health per the above major criteria, except for an input that is required to meet local fire codes.

I. Recycling Characteristics: Provide documentation that the shade cloth can and is part of a closed loop of perpetual use and not be required to be down cycled, incinerated or otherwise thrown away. Scrap material can be sent back to the mill for reprocessing and recycling into the same quality yarn and woven into new material, without down cycling. Certify that this process is currently underway and will be utilized for this project.

J. Perpetual Use Certification: Certify that at the end of the useful life of the shade cloth, that the material can be sent back to the manufacturer for recapture as part of a closed loop of perpetual use and that the material can and will be reconstituted into new yarn, for weaving into new shade cloth. Provide information on each shade band indicating that the shade band can be sent back to the manufacturer for this purpose.

K. Use only injection-molded Delrin engineered plastics by Dupont for all plastic components of shade hardware. Styrene based, PVC, or glass reinforced polyester thermo polymer plastics are not acceptable.

L. Mock-Up: Provide a mock-up (manual shades only) of one roller shade assembly for evaluation of mounting, appearance and accessories. Locate mock-up in window designated by Architect. Do not proceed with remaining work until mock-up is accepted by Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 WARRANTY

A. Roller Shade Hardware, Chain and Shade fabric: Manufacturer's standard non-depreciating, fit-for-use (includes normal wear & tear), twenty-five year limited warranty. Warranty to transfer to owner upon completion of installation.

B. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating 8-year warranty, as installed by Authorized Dealer.

C. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer, as basis of design, performance and warranty: MechoShade Systems, Inc.; as represented by ARCHITYPE, Tel: (310) 652-2263. Fax: (310) 652-2264, Contact: Jean-Guy Poitras. Email: jean-guyp@mechoshade.com, jgpoitras@architype.com.

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 APPLICATIONS/SCOPE

A. Roller Shade Schedule:
Shade WT-1: Manual operating, chain drive, sunscreen roller shades at specified exterior windows of rooms and spaces as shown on the Drawings, recessed in ceiling pocket.
Product: Mechoshade 5, Manual Solar Shade

Shade WT-2: Motorized interior "double", solar and room darkening blackout roller shades, operating independently of each other, in all exterior windows of rooms and spaces shown on Drawings, and related motor control systems. Mounted in recessed pocket.
Product: ElectroShade 1, Motorized Dual Solar plus Blackout Shade.

2.3 SHADE CLOTH

A. Vinyl Room Darkening Shadecloth (Single-Fabric): MechoShade Systems, Inc., "0700 series", blackout material, washable and colorfast laminated and embossed vinyl coated fabric, 0.012 inches thick (0.30 mm) blackout material and weighing 0.81 lbs. per square

yard, with a minimum of 62 threads per square inch in colors selected from manufacturer's available range.

B. Environmentally Certified Shadecloth: MechoShade Systems, Inc., EcoVeil group, 1550 Series (3% openness), fabricated from TPO for both core yarn and jacket, single thickness, non-raveling 0.030 inch (0.762 mm) thick fabric.
Weave: 3 percent open, 2 x 2 basket weave.

2.4 SHADE BAND

A. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
Shade band and Shade Roller Attachment:
   a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection. Roller tubes less than 1.55 inch (39.37 mm) in diameter for manual shades, and less than 2.55 inches (64.77 mm) for motorize shades are not acceptable.
   b. Provide for positive mechanical engagement with drive / brake mechanism.
   c. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.
   d. Mounting spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
   e. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets are not acceptable.

2.5 SHADE FABRICATION

A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.

B. Fabricate shadecloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design.
Fabricate hem as follows:
Bottom hem weights.

C. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shadebands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be

responsible for establishing appropriate standards to assure proper tracking and rolling of the shadecloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.

D. For railroaded shadebands, provide seams in railroaded multi-width shadebands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer's standards. In absence of such standards, assure proper use of seams or battens as required to, and assure the proper tracking of the railroaded multi-width shadebands.

E. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer's standards. In absence of manufacturer's standards, be responsible for proper use and placement of battens to assure proper tracking and roll of shadebands.

F. Blackout shadebands, when used in side channels, shall have horizontally-mounted, roll-formed stainless steel or tempered-steel battens not more than 3 feet (115 mm) on center extending fully into the side channels. Battens shall be concealed in a integrally-colored fabric to match the inside and outside colors of the shadeband, in accordance with manufacturer's published standards for spacing and requirements.
Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.
Batten pockets shall be self-colored fabric front and back RF welded into the shadecloth. A self-color opaque liner shall be provided front and back to eliminate any see through of the batten pocket that shall not exceed 1-1/2 inches (38.1 mm) high and be totally opaque. A see-through moiré effect, which occurs with multiple layers of transparent fabrics, shall not be acceptable.

2.6 COMPONENTS

A. Access and Material Requirements:
Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
Use only Delrin engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester will not be acceptable.

B. Motorized Shade Hardware and Shade Brackets:
Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade.

Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
Provide shade hardware system that allows for operation of multiple shade bands offset by a maximum of 8-45 degrees from the motor axis between shade bands (4-22.5 degrees) on each side of the radial line, by a single shade motor (multi-banded shade, subject to manufacturer's design criteria).

C. Manual Operated Chain Drive Hardware and Brackets:
Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer's design criteria.
Connectors shall be offset to assure alignment from the first to the last shade band.
Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable
Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel or heavier as required to support 150 percent of the full weight of each shade.
Drive Bracket / Brake Assembly:

a. MechoShade Drive Bracket model M5 shall be fully integrated with all MechoShade accessories, including, but not limited to: SnapLoc fascia, room darkening side / sill channels, center supports and connectors for multi-banded shades.
b. M5 drive sprocket and brake assembly shall rotate and be supported on a welded 3/8 inch (9.525 mm) steel pin.
c. The brake shall be an over -running clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. (22 kg) in the stopped position.
d. The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes an articulated brake assembly, which assures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated. Products that require externally applied lubrication and or not permanently lubricated are not acceptable.
e. The entire M5 assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.

D. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. (41 kg) minimum breaking strength. Nickel plate chain shall not be accepted.

2.7 SHADE MOTOR DRIVE SYSTEM

A. Shade Motors:

Tubular, asynchronous (non-synchronous) motors, with built-in reversible capacitor operating at 110v AC (60hz), single phase, temperature Class A, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each motor.
Conceal motors inside shade roller tube.
Maximum current draw for each shade motor of 2.3 amps.
Use motors rated at the same nominal speed for all shades in the same room.

B. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade motor and tube assembly.

2.8 MOTOR CONTROL SYSTEMS

A. IQ/MLC: Specifications and design of shade motors and motor control system are based on the IQ/MLC motor logic control system manufactured by MechoShade Systems, Inc. Other systems may be acceptable provide that all of the following performance capabilities are provided. Motor logic control systems not in complete compliance with these performance criteria shall not be accepted as equal systems.
Motor Control System:
   a. Provide power to each shade motor via individual 3 conductor line voltage circuits connecting each motor to the relay based motor logic controllers (IQ/MLC).
   b. Control system components shall provide appropriate (spike and brown out) over-current protection (+/- 10 percent of line voltage) for each of the four individual motor circuits and shall be rated by UL or ETL as a recognized component of this system and tested as an integrated system.
   c. Motor control system shall allow each group of four shade motors in any combination to be controlled by each of four local switch ports, with up to fourteen possible "sub-group" combinations via local 3 button wall switches and all at once via a master 3 button switch. System shall allow for overlapping switch combinations from two or more local switches.
   d. Multiple "sub-groups" from different IQ/MLC control components shall be capable of being combined to form "groups" operated by a single 3 button wall switch, from either the master port or in series from a local switch port.
   e. Each shade motor shall be accessible (for control purposes) from up to four local switches and one master switch.
   f. Control system shall allow for automatic alignment of shade hem bars in stopped position at 25 percent, 50 percent, and 75 percent of opening heights, and up to three user-defined intermediate stopping positions in addition to all up / all down, regardless of shade height, for a total of five positions. Control system shall allow shades to be stopped at any point in the opening height noting that shades may not be in alignment at these non-defined positions).
   g. Control system shall have two standard operating modes: Normal mode allowing the shades to be stopped anywhere in the window's opening height and uniform mode, allowing the shades to only be stopped at the predefined

intermediate stop positions. Both modes shall allow for all up / all down positioning.

h. Control system components shall allow for interface with both audiovisual system components and building fire and life safety system via a dry contact terminal block.

i. Control system components shall allow for interface with external analog input control devices such as solar activated controllers, 24 hour timers, and similar items; via a dry contact terminal block.

j. Reconfiguration of switch groups shall not require rewiring of the hardwired line voltage motor power supply wiring, or the low voltage control wiring. Reconfiguration of switch groups shall be accomplished within the motor control device (IQ/MLC).

Wall Switches:

k. Three-button architectural flush mounted switches with metal cover plate and no exposed fasteners.

l. Connect local wall switches to control system components via low voltage (12V DC) 4-conductor modular cable equipped with RJ-11 type connectors supplied, installed and certified under Division 16 - Electrical.

m. Connect master wall switches to control system components via low voltage (12V DC) 6-conductor modular cable equipped with RJ-12 type connectors supplied, installed and certified under Division 16 - Electrical.

n.

2.9 ACCESSORIES

A. Roller Shade Pocket for recessed mounting in acoustical tile, or drywall ceilings as indicated on the Drawings.
Provide either extruded aluminum and or formed steel shade pocket, sized to accommodate roller shades, with exposed extruded aluminum closure mount, tile support and removable closure panel to provide access to shades.

B. Room Darkening Side and / or Sill Channels are not required.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow proper clearances for window operation hardware.

B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

C. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

D. Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 36 00

SOLID SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinetwork.

1.02 RELATED REQUIREMENTS

A. Section 06 41 00 - Laminate-Clad Wood Casework.

B. Section 22 40 00 - Plumbing Fixtures: Sinks.

1.03 REFERENCE STANDARDS

A. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2006.

B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2008.

C. ISSFA-2 - Classification and Standards for Solid Surfacing Material; International Solid Surface Fabricators Association; 2001 (2002)

D. WI (MAN) - Manual of Millwork; Woodwork Institute; 2003.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

F. LEED Report: Submit for low-emitting materials

G. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Same fabricator as for cabinets on which tops are to be installed.

B. Installer Qualifications: Fabricator.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOP ASSEMBLIES

A. Solid Surfacing Countertops: Solid polymer surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISSFA-2 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Surface Burning Characteristics: Flame spread 25, maximum; smoke developed 450, maximum; when tested in accordance with ASTM E 84.
      b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
      c. Color/Pattern Family: Refer to Section 09 00 00.
      d. Manufacturers:
         1) Dupont: www.corian.com.
         2) Avonite Surfaces: www.avonitesurfaces.com.
         3) Or equal
         4) Substitutions: See Section 01 60 00 - Product Requirements.
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

2.02 ACCESSORY MATERIALS

A. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

B. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch by 1/2 inch; color as selected.

C. Joint Sealant: Mildew-resistant silicone sealant, white.

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Seal joint between back/end splashes and vertical surfaces.
   1. Where indicated use rubber cove molding.
   2. Where applied cove molding is not indicated use specified sealant.

3.04 CLEANING

A. Clean countertops surfaces thoroughly.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 93 13

BICYCLE RACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bicycle racks.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Mounting surface for bicycle racks.

B. Section 05 5000 - Metal Fabrications: Custom metal outdoor furnishings.

1.03 REFERENCE STANDARDS

A. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2007.

B. ASTM A 500/A 500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2010.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Outdoor Bicycle Racks:
   1. Columbia Cascade Company: www.timberform.com.
   2. Creative Pipe, Inc: www.creativepipe.com.
   3. Highland Products Group, LLC: www.indoorbikeracks.net.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BICYCLE RACKS

A. Exterior Bicycle Racks: Device allows user provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
   1. Style: Serpentine rack formed from a continuous round pipe.
   2. Capacity:20 bicycles.
   3. Mounting, Ground: In-ground anchor.
   4. Finish: Powder coat, maintenance-free and weather-resistant.
   5. Color: As selected by DLR Group WWCOT from manufacturer's standard range.
   6. Accessories: In-ground grout cover.

B. Interior Bicycle Racks: Device designed for indoor storage of bicycles; allows user provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
   1. Capacity:__ bicycles.

C. Materials:
   1. Pipe: Carbon steel, ASTM A 53/A 53M, Schedule 40.

PART 3 EXECUTION

3.01 PREPARATION

A. Ensure surfaces to receive bicycle racks are clean, flat, and level.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install bicycle racks level, plumb, square, and correctly located as indicated on the drawings.

C. In-Ground Anchor Installation:
   1. Prepare holes in size according to manufacturer's instructions.
   2. Place anchoring bolts through the holes in the pipe.
   3. Lower rack into holes, ensuring the bottom of lower bends are at least 1-1/2 inch from the ground.
   4. Pour concrete and level rack.
   5. Support until dry.

3.03 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 21 05 00

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes pipe, fittings, valves, and connections for sprinkler system.

B. Related Sections:

1. Division 03 - Concrete Forming and Accessories: Execution requirements for inserts and sleeves specified by this section.
2. Division 09 - Painting and Coating: Execution requirements for piping painting specified by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
2. ASME B16.11 - Forged Steel Fittings - Socket-Welding and Threaded.
3. ASME B16.25 - Buttwelding Ends.
4. ASME B16.3 - Malleable Iron Threaded Fittings.
5. ASME B16.4 - Gray Iron Threaded Fittings.
6. ASME B16.5 - Pipe Flanges and Flanged Fittings.
7. ASME B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.

B. ASTM International:

1. ASTM A47 – Standard Specification for Ferric Malleable Iron Castings.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A135 - Standard Specification for Electric-Resistance-Welded Steel Pipe.
4. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
5. ASTM A795 – Standard Specification for Black and Hot-Dipped Zink-Coated (galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. American Water Works Association:

1. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
2. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
4. AWWA C105 – Polyethylene Encasement for Ductile Iron Pipe Systems.

E. National Fire Protection Association:

1. NFPA 13 - Installation of Sprinkler Systems.
2. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

C. Product Data: Submit manufacturers' catalogue information. Indicate valve data and ratings.

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

1.04 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of components and tag numbering.

C. Operation and Maintenance Data: Submit spare parts lists.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with NFPA 13 standard.

B. Maintain one copy of each document on site.

1.06 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.07 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Product storage and handling requirements.

B. Deliver and store valves in shipping containers, with labeling in place.

C. Furnish cast iron and steel valves with temporary protective coating.

D. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.09 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for basic fire suppression materials and methods.

1.10 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two sets of valve stem packing for each size and type of valve installed.

PART 2 PRODUCTS

2.01 VALVES

A. Manufacturers:

1. Milwaukee.
2. Stockham.
3. Kennedy.
4. Mueller.
5. Substitutions: Division 01 - Product Requirements.

B. Gate Valves:

1. Up to and including 2 inches: Bronze body and trim, rising stem, hand wheel, solid wedge or disc, threaded ends. Similar to Stockham Model No. B-133.
2. Over 2 inches: Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, hand wheel, OS&Y, solid bronze or cast iron wedge, flanged ends. Similar to Stockham Model No. G-634.

C. Globe or Angle Valves:

1. Up to and including 2 inches: Bronze body, bronze trim, rising stem and hand wheel, inside screw, renewable Buna n Seat disc, threaded ends, with back seating capacity. Similar to Kennedy Model No. 98-SD.

D. Ball Valves:

1. Up to and including 2 inches: Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle, threaded ends. Similar to Kennedy Model No. 775.

E. Butterfly Valves:

1. Bronze Body: Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, hand wheel and gear drive and integral indicating device , and built-in tamper proof switch rated 10 amp at 115 volt AC.
2. Cast or Ductile Iron Body: Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends. With extended neck, hand wheel and gear drive and integral indicating device, and external tamper switch rated 10 amp at 115 volt AC.

F. Check Valves:

1. Up to and including 2 inches: Bronze body and swing disc, rubber seat, threaded ends. Similar to Stockham Model No. B-319Y.
2. Over 2 inches: Iron body, bronze trim, swing check, renewable disc and seat, flanged ends. Similar to Stockham Model No. G-939.
3. 4 inches and Over: Iron body, bronze disc with stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

2.02 BURIED PIPING

A. Ductile Iron: AWWA C151.

1. Fittings: AWWA C110, ductile iron standard thickness.
2. Joints: AWWA C111, rubber gasket.
3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.
4. Jackets: AWWA C105, polyethylene jacket for corrosive soils.

2.03 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A53/A53M, Grade B; ASTM A135; ASTM A135 UL listed, threadable, light wall for mains larger than 2 inch; or ASTM A795; Schedule 40 black, outside applications shall be galvanized pipe. Pipes shall have a corrosion resistance ratio (CRR) of 1.00 or greater per UL listing. Piping shall be black carbon steel, except in FM approved dry systems, where pipe shall be hot-dipped galvanized to meet ASTM A795 zinc coating specifications.
Pipe shall be Schedule 40 or equal; for 2 inches and smaller. Threaded joints and fittings. Schedule 10 for pipes size 2-1/2 inches or larger. Victaulic or grooved fittings may be used.

1. Steel Fittings: ASME B16.9, wrought steel, butt welded; ASME B16.25, butt weld ends; ASTM A234/A234M, wrought carbon steel and alloy steel; ASME B16.5, steel flanges and fittings; or ASME B16.11, forged steel socket welded and threaded.
2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings; or ASME B16.4, threaded fittings.
3. Malleable Iron Fittings: ASME B16.3, threaded fittings or ASTM A47.

2.04 PIPE HANGERS AND SUPPORTS

A. Conform to NFPA 13.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.

D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

E. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.

F. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

G. Vertical Support: Steel riser clamp.

H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install piping in accordance with NFPA 13 for sprinkler systems and NFPA 24 for service mains.

B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

C. Install piping to conserve building space, to not interfere with use of space and other work.

D. Group piping whenever practical at common elevations.

E. Pipe through floors, wall, and ceilings, at head locations, shall be equipped with approved sleeves and escutcheons. Escutcheons shall be polished chrome plated.

F. Install pipe sleeve at piping penetrations through footings, walls, and floors. Seal pipe and sleeve penetrations to maintain fire resistance equivalent to fire separation.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

H. Pipe Hangers and Supports:

1. Install in accordance with NFPA 13.
2. Install hangers to with minimum 1/2 inch space between finished covering and adjacent work.
3. Place hangers within 12 inches of each horizontal elbow.
4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
6. Where installing several pipes in parallel and at same elevation, provide multiple or trapeze hangers.

7. Prime coat exposed steel hangers and supports. Refer to Division 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

I. Slope piping and arrange systems to drain at low points. Install eccentric reducers to maintain top of pipe level.

J. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Division 09.

K. Do not penetrate building structural members unless indicated.

L. Where more than one piping system material is specified, install compatible system components and joints. Install flanges, union, and couplings at locations requiring servicing.

M. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

N. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.

O. Install gate or butterfly valves for shut-off or isolating service.

P. Install drain valves at main shut-off valves, low points of piping and apparatus.

Q. Sprinkler system shall be provided with complete drainage facilities in accordance with UBC Std drain discharge shall not spill on grade. It shall go into a sewer.

R. Where inserts are omitted, drill through concrete slab from below and install through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

S. Upon completion and prior to acceptance of installation, Contractor shall subject system, including underground supply connections, to tests required by UBC Std and shall furnish the County with a certificate of compliance as required.

T. Close nipples shall not be used. Threaded unions shall not be installed in concealed areas unless provided with an approved access panel.

U. Fire sprinkler systems piping hanger and supports shall conform to the UBC Std requirements.

V. Underground pipe shall be laid on a flat undisturbed sand bed. After required pressure-leak test, pipe shall be covered with sand not less than 6 inches thick, prior to backfilling.

W. Piping to a sprinkler head in the elevator machine room or elevator shaft shall not go out of the room or shaft.

X. Provide shunt trip on sprinklers located in the elevator machine rooms and elevator hoist way unless the sprinklers are located 2 feet or less from the pit floor.

3.03 INTERFACE WITH OTHER PRODUCTS

A. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Install hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.04 CLEANING

A. Division 01 - Execution and Closeout Requirements: Final cleaning.

B. Clean entire system after other construction is complete.

END OF SECTION

SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes wet-pipe sprinkler system, system design, installation, and certification.

B. Related Sections:

1. Division 09 - Paints and Coatings.
2. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections to equipment specified by this section.
3. Section 31 22 00: For Excavation requirements

1.02 REFERENCES

A. National Fire Protection Association:

1. NFPA 13 - Installation of Sprinkler Systems.

1.03 SYSTEM DESCRIPTION

A. Section Includes: Furnish and install fire sprinkler system for protection of all required areas of the entire building including attic and between floor spaces unless otherwise indicated. Items required for this work include but are not limited to:

1. Automatic wet pipe fire sprinkler system.
2. Preparation of complete shop installation drawings for the fire sprinkler systems and approvals.
3. Required permits, licenses and inspections.
4. Cleaning, testing and adjusting.
5. Project record documents of work as installed.

B. Provide hydraulically designed system to NFPA 13 occupancy requirements.

1. Hydraulic calculations shall be based on a format acceptable to the State Fire Marshal and the City or County fire authority. Calculations shall be performed utilizing no more than 90 percent of the minimum available water supply.
2. Approval by the fire authorities may cover minimum legal requirements and does not supersede more extensive contractual requirements.

C. Determine volume and pressure of incoming water supply from water flow test data.

D. Interface system with building fire and smoke alarm system.

1.04 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate layout of finished ceiling areas indicating sprinkler locations coordinated with ceiling installation. Indicate detailed pipe layout, hangers and supports, seismic restraint details, sprinklers, components and accessories.

1. Shop drawings shall be prepared and be signed by a licensed fire protection engineer of the State of California.
2. Installation of fire sprinkler system shall not start until approved drawings have been returned to Contractor by the architect. Alignment of fire sprinklers and relationship to ceiling tile locations shall be as approved by the architect.

C. Product Data: Submit data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

D. Design Data: Submit design calculations; signed and sealed by professional engineer.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.05 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations. Record prints as installed shall be kept current on site, available for Fire Inspector and the County Inspector to review. At completion of installation, record prints shall be signed by installer and delivered to the architect for correcting tracings to record drawing status.

C. Operation and Maintenance Data: Submit components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

1.06 QUALITY ASSURANCE

A. Standards: Comply with applicable national or local codes and standards: ASTM, ASME, ANSI, IAPMO, Federal Specifications, MSS Specifications, AWWA, CISPI, NFPA, FM, UL, UPC, UMC.

B. Unless otherwise noted, provisions of NFPA 13, Standard for Installation of Sprinkler Systems, are made part of this section.

C. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. Design system under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of California.

1.08 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Product storage and handling requirements.

B. Store products in shipping containers until installation.

C. Deliver and store valves in shipping containers with labeling in place.

D. Provide temporary protective coating on cast iron and steel valves.

E. Furnish piping with temporary inlet and outlet caps until installation.

1.10 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for all valves.

1.11 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish extra sprinklers under provisions of NFPA 13.

C. Furnish suitable wrenches for each sprinkler type.

D. Furnish metal storage cabinet located adjacent to alarm valve or as directed by the Inspector.

PART 2 PRODUCTS

2.01 SPRINKLERS

A. Manufacturers:

1. Ansul Incorporated.
2. Automatic Sprinkler Corp.
3. Grinnell Corp.
4. Reliable Sprinkler Corp.
5. Substitutions: Division 01 - Product Requirements.

B. Suspended and Hard Lid Ceiling Type:

1. Type: Recessed or Concealed pendant type with matching push on or screw on escutcheon plate.
2. Finish: Chrome plated, or Enamel, color white as directed by the Architect.
3. Escutcheon Plate Finish: Chrome plated or Enamel, color white as directed by the Architect.

4. Fusible Link: Quick response, glass bulb type temperature rated for specific area hazard.
5. Similar to Reliable Model No. FIFR or G4A.

C. Exposed Area Type:

1. Type: Standard upright type with guard as required.
2. Finish: Brass.
3. Fusible Link: Quick response glass bulb type temperature rated for specific area hazard.
4. Similar to Reliable Model No. FIFR.

D. Side wall Type:

1. Type: Standard or Recessed horizontal side wall type with matching push on or screw on escutcheon plate as directed by the Architect.
2. Finish: Chrome plated, enamel, color white , as directed by the Architect.
3. Escutcheon Plate Finish: Chrome plated or Enamel, color white as directed by the Architect.
4. Fusible Link: Quick response glass bulb type temperature rated for specific area hazard.
5. Similar to Reliable Model No. FIFR.

E. Guards: Finish to match sprinkler finish.

2.02 PIPING SPECIALTIES

A. Wet Pipe Sprinkler Alarm Valve: Check type valve with EPDM seat, clapper to automatically actuate water motor alarm, with pressure retard chamber and variable pressure trim similar to Reliable Model No. E.

B. Sprinkler Inspector's Test Fittings:

1. Standard: UL's listed or FM Global approved.
2. Pressure Rating: 3000 psig.
3. Body Material: Bronze body, brass stem, steel handle, chrome-plated bronze ball, virgin Teflon valve seat. Sight Glass: Bronze housing with viewing window.
4. Components: A tamper resistant test orifice and a tapped port for system access.
5. Test Orifice Size: Nominal ½" as required by NFPA.
6. Size: F.I.P.T., same as connected piping.
7. Inlet and Outlet: Threaded.
8. Similar to AGF Model No. 3011SG.

C. Water Motor Alarm: Vibrating type electric bell, 10-inch, 120 Volt, suitable for outdoor use, capable of mounting on a standard 4-inch square electrical box, red powder coating. Similar to Potter Electric, Model No. PBA12010.

D. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC. Similar to Potter Electric Model No. VSR.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with NFPA 13.

B. Install buried shut-off valves in valve box. Furnish post indicator.

C. Locate outside alarm-gong on building wall as indicated on Drawings or as required by the authority having jurisdiction.

D. Place pipe runs to minimize obstruction to other work.

E. Install piping in concealed spaces above finished ceilings.

F. Center sprinklers in two directions in ceiling tile and install piping offsets.

G. Install guards on sprinklers as required by NFPA 13.

H. Hydrostatically test entire system.

I. Require test be witnessed by authority having jurisdiction.

3.02 INTERFACE WITH OTHER PRODUCTS

A. Verify signal devices are installed and connected to fire alarm system.

3.03 CLEANING

A. Flush entire piping system of foreign matter.

3.04 PROTECTION OF INSTALLED CONSTRUCTION

A. Apply masking tape or paper cover to protect concealed sprinklers, cover plates, and sprinkler escutcheons not receiving field paint finish. Remove after painting. Replace painted sprinklers with new.

END OF SECTION

SECTION 22 05 03

PIPES AND TUBES FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Pipe and pipe fittings for the following systems:

1. Domestic water piping, buried within 5 feet of building.
2. Domestic water piping, above grade.
3. Sanitary sewer piping, buried within 5 feet of building.
4. Sanitary sewer piping, above grade.
5. Storm water piping, buried within 5 feet of building.
6. Storm water piping, above grade.
7. Equipment drains and over flows.
8. Flexible connectors.
9. Unions and flanges.

B. Related Sections:

1. Division 07 - Firestopping: Product requirements for firestopping for placement by this section.
2. Division 08 - Access Doors and Frames: Product requirements for access doors for placement by this section.
3. Division 09 - Painting and Coating: Product and execution requirements for painting specified by this section.
4. Section 22 05 23 - General-Duty Valves for Plumbing Piping: Product requirements for valves for placement by this section.
5. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports [and firestopping] for placement by this section.
6. Section 22 07 00 - Plumbing Insulation: Product requirements for piping insulation for placement by this section.
7. Section 32 11 00 Base - Aggregates for Earthwork: Aggregate for backfill in trenches.
8. Section 31 22 00 - Grading: Product and execution requirements for excavation, trenching and backfill required by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
3. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
4. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

5. ASME B31.9 - Building Services Piping.
6. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:

1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
2. ASTM A888 – Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
3. ASTM B32 - Standard Specification for Solder Metal.
4. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
5. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
6. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
7. ASTM D1248 – Standard Specification for Polyethylene Plastics Molding and Extrusion Material.

C. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

D. American Water Works Association:

1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

E. Cast Iron Soil Pipe Institute:

1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes. Submit shop drawings sealed by registered professional engineer.

C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.

D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used. Submit sizing methods and calculations sealed by registered professional engineer.

E. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Maintain one copy of each document on site.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 5 years documented experience approved by manufacturer.

C. Design piping systems with pipe hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of California.

1.06 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 COORDINATION

A. Division 01 - Administrative Requirements: Requirements for coordination.

PART 2 PRODUCTS

2.01 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Ductile Iron Pipe: AWWA C151 with cement lining as per AWWA, C104.
   1. Fittings: AWWA C110, ductile iron, standard thickness.
   2. Joints: AWWA C111, rubber gasket with rods.
   3. Jackets: AWWA C105 polyethylene jacket].

B. Copper Tubing: ASTM B88, Type K annealed.
   1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
   2. Joints: Compression connection or Brazed, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

2.02 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L, hard drawn.

   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.03 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Soil Pipe: ASTM A888 plain ends.
   1. Fittings: Cast iron, ASTM A888.
   2. Joints: CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
   3. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.

B. Cast Iron Pipe: CISPI 301, hub-less.
   1. Fittings: Cast iron, CISPI 301.
   2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
   3. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.

C. Polyethylene Encasement: ASTM D1248 polyethylene tube or sheet form to encase cast iron pipe, with minimum 0.008 inch (0.20 mm) thickness. Install encasement as per ASTM A74 and manufacturer's recommendations.

2.04 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A888, service weight.

   1. Fittings: Cast iron, ASTM A888.
   2. Joints: ASTM C564, rubber gasket joint devices or lead and oakum.
   3. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.

B. Cast Iron Pipe: CISPI 301, hub-less, service weight.

   1. Fittings: Cast iron, CISPI 301.
   2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
   3. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.

C. Copper Tube: ASTM B306, DWV.

1. Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper.
2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.05 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A888, plain ends.

1. Fittings: Cast iron, ASTM A888.
2. Joints: ASTM C564, rubber gasket joint devices or lead and oakum.
3. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron, CISPI 301.
2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
3. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.

C. Polyethylene Encasement: ASTM D1248 polyethylene tube or sheet form to encase cast iron pipe, with minimum 0.008 inch (0.20 mm) thickness. Install encasement as per ASTM A74 and manufacturer's recommendations.

2.06 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A888 plain ends.

1. Fittings: Cast iron, ASTM A888.
2. Joints: ASTM C564, neoprene gasket system or lead and oakum.
3. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron, CISPI 301.
2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
3. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.

2.07 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tubing: ASTM B88, Type DWV, hard drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.08 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Flex-Hose Co., Inc.
2. Flex-Weld, Inc./Keflex.
3. The Metraflex Company.

4. Twin City Hose, Inc.
5. USHose Corp.
6. Substitutions: Division 01 - Product Requirements.

B. 2 inches and Smaller: Corrugated stainless steel hose with single layer of stainless steel exterior braiding, copper tubing ends; maximum working pressure 170 psig, threaded or soldered connections.

C. 2-1/2 inches and Larger: Corrugated stainless steel hose with single layer of stainless steel exterior braiding, Class 150 flanged ends; maximum working pressure 190 psig.

2.09 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.
2. Copper Piping: Class 150, bronze unions with soldered.
3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
2. Copper Piping: Class 150, slip-on bronze flanges.
3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.03 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection size, location, and invert are as indicated on Drawings.

B. Establish elevations of buried piping with not less than 1 ft of cover.

C. Establish minimum separation of 1 foot from other services piping in accordance with CPC code.

D. Excavate pipe trench in accordance with Section 31 23 17.

E. Install pipe to elevation as indicated on Drawings or as required.

F. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 6 inches compacted depth; compact to 95 percent maximum density.

G. Install pipe on prepared bedding.

H. Route pipe in straight line.

I. Install pipe to allow for expansion and contraction without stressing pipe or joints.

J. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section.

K. Install plastic ribbon tape continuous over top of pipe, 6 inches above pipe line.

L. Install trace wire continuous over top of pipe, 6 inches above pipe line.

M. Pipe Cover and Backfilling:
   1. Backfill trench in accordance with Section 31 23 23.
   2. Maintain optimum moisture content of fill material to attain required compaction density.
   3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
   4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
   5. Do not use wheeled or tracked vehicles for tamping.

3.04 INSTALLATION - ABOVE GROUND PIPING

A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

C. Group piping whenever practical at common elevations.

D. Sleeve pipe passing through partitions, walls and floors. Refer to Section 22 05 29.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 00.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Division 08.

I. Install non-conducting dielectric connections wherever jointing dissimilar metals.

J. Establish invert elevations, slopes for drainage to ¼ inch per foot minimum. Maintain gradients unless otherwise indicated.

K. Slope piping and arrange systems to drain at low points.

L. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

M. Where pipe support members are welded to structural building framing, scrape, brush clean and apply one coat of zinc rich primer to welding.

N. Prepare pipe, fittings, supports and accessories not prefinished, ready for finish painting.

O. Install valves with steams upright or horizontal, not inverted.

P. Provide firestopping at fire rated walls, floors or ceiling assemblies under provisions of Division 7.

Q. Install piping penetrating roofed areas to maintain integrity of roof assembly.

R. Install valves in accordance with Section 22 05 23.

S. Insulate piping. Refer to Section 22 07 00.

3.05 INSTALLATION - DOMESTIC WATER PIPING SYSTEMS

A. Install domestic water piping system in accordance with CPC.

3.06 INSTALLATION - SANITARY WASTE AND VENT PIPING SYSTEMS

A. Install sanitary waste and vent piping systems in accordance with CPC.

3.07 INSTALLATION - STORM DRAINAGE PIPING SYSTEMS

A. Install storm drainage piping systems in accordance with CPC plumbing code.

B. Support cast iron drainage piping at every joint.

3.08 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

C. Install ball valves for shut-off and to isolate equipment or part of system. Install access panel in hard ceilings and or walls as indicated on plans.

D. Install globe or ball valves for throttling, bypass or manual flow control services. Install access panel in hard ceilings and or walls as indicated on plans.

3.09 FIELD QUALITY CONTROL

A. Division 01 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Test domestic water piping system in accordance with applicable code.

C. Test sanitary waste and vent piping system in accordance with applicable code.

D. Test storm drainage piping system in accordance with applicable code.

3.10 CLEANING

A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.

3.11 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect ion of potable water system shall comply with ANSI/AWWA C651-92.

B. When hot and cold water piping, including fixtures, have been installed, tested and accepted. Disinfect the system using any of the three methods of chlorination explained in AWWA C651-92 standard.

C. The basic disinfection procedure shall consists of:

1. Preventing contaminating materials from entering the water piping system during storage, construction or repair.
2. Removing, by flushing or other means, those materials that may have entered the water piping system.
3. Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the piping system.
4. Protecting the existing distribution system from backflow due to hydrostatic pressure test and disinfection procedures.
5. Determining the bacteriological quality by laboratory test after disinfect ion. At least one water sample from the existing distribution system shall be tested.
6. Final connection of the water piping system to the active distribution system.

D. Submit Record of Compliance: The record of compliance shall be the bacteriological test results certifying the water sampled from the water piping system to be free of coliform bacteria contamination, and to be equal to or better than the bacteriologic water quality in the distribution system.

END OF SECTION

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Ball valves.
2. Check valves.

B. Related Sections:

1. Section 22 05 03 - Pipes and Tubes for Plumbing Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
2. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product and installation requirements for pipe hangers and supports.
3. Section 22 07 00 - Plumbing Insulation: Product and installation requirements for insulation for valves.

1.02 REFERENCES

A. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
2. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.

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

1.04 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of valves.

C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each document on site.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.

1.07 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install valves underground when bedding is wet or frozen.

1.10 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish five year manufacturer warranty for valves excluding packing.

1.11 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Requirements for extra materials.

B. Furnish two packing kits for each size valve.

PART 2 PRODUCTS

2.01 BALL VALVES

A. Manufacturers:

1. Crane Valve, North America.
2. Milwaukee Valve Company.

3. NIBCO, Inc.
4. Stockham Valves & Fittings.
5. Substitutions: Division 01 - Product Requirements.

B. 2 inches and Smaller: MSS SP 110, 600 psi WOG, two-piece bronze body, 316 stainless steel ball full port, PTFE seats, blow-out proof stem, threaded ends, lever handle. Similar to Nibco Model T-580-70-66

2.02 CHECK VALVES

A. Horizontal Swing Check Valves:

1. Manufacturers:
   a. Crane Valve, North America.
   b. Milwaukee Valve Company.
   c. NIBCO, Inc.
   d. Stockham Valves & Fittings.
   e. Substitutions: Division 01 - Product Requirements.

2. 2 inches and Smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, bronze disc, solder or threaded ends. Similar to Nibco Model T-433.
3. 2-1/2 inches and Larger: MSS SP 71, Class 125, cast iron body, bolted cap, bronze or cast iron disc, renewable disc seal and seat, flanged ends. Similar to Nibco Model F-918-B.

2.03 EXAMINATION

A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify piping system is ready for valve installation.

2.04 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

D. Install valves with clearance for installation of insulation and allowing access.

E. Provide access where valves and fittings are not accessible.

F. Refer to Section 22 05 29 for pipe hangers.

G. Refer to Section 22 07 00 for insulation requirements for valves.

H. Refer to Section 22 05 03 for piping materials applying to various system types.

I. For installation of valves in storm systems refer to Section 22 14 00.

2.05 VALVE APPLICATIONS

A. Install ball for shut-off and to isolate equipment, part of systems, or vertical risers.

B. Install ball valves in domestic water systems for shut-off service.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Firestopping relating to plumbing work.
4. Firestopping accessories.

B. Related Sections:

1. Division 07 - Firestopping: Product requirements for firestopping for placement by this section.
2. Division 07 - Joint Protection: Product requirements for sealant materials for placement by this section.
3. Division 09 - Painting and Coating: Product and execution requirements for painting specified by this section.
4. Section 22 05 03 - Pipes and Tubes for Plumbing Piping and Equipment: Execution requirements for placement of hangers and supports specified by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.03 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.04 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E119, ASTM E814, UL 263 and UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.

B. Surface Burning: ASTM E84, UL 723 with maximum flame spread / smoke developed rating of 25/450.

C. Firestop interruptions to fire rated assemblies, materials, and components.

1.05 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to FM or UL for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.06 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

C. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit sizing methods and calculations sealed by a registered professional engineer.

F. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.07 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
2. Floor Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
   a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

G. Maintain one copy of each document on site.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum 3 years documented experience.

1.09 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

1.12 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.13 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for pipe hangers and supports.

PART 2 PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Carpenter & Paterson Inc.
2. Creative Systems Inc.
3. Flex-Weld, Inc.

4. Glope Pipe Hanger Products Inc.
5. Michigan Hanger Co.
6. Superior Valve Co.
7. Tolco.
8. Substitutions: Division 01 - Product Requirements.

B. Plumbing Piping - DWV:

1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69, or MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel], adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.

C. Plumbing Piping - Water:

1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 or MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
7. Vertical Support: Steel riser clamp.
8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Copper Pipe Support: Copper-plated, Carbon-steel ring.

2.02 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.03 MANUFACTURERS – SEISMIC BRACING

A. Systems: Products of B-Line, Inc., Oakland, CA, are the standard of quality required and specified herein. Similar products of other manufacturers meeting the same standards of performance and approved by OSHPD or ORS/DSA may be submitted for approval.

2.04 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products.

6. Specified Technology, Inc.
7. Substitutions: Division 01 - Product Requirements.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: As selected from manufacturer's full range of colors.

2.05 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.
4. Plywood or particle board.
5. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Obtain permission from Architect/Engineer before using powder-actuated anchors.

D. Do not drill or cut structural members.

3.03 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.04 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.1, ASME 31.9, ASTM F708, MSS SP 58, MSS SP 69 or MSS SP 89.

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

I. Support riser piping independently of connected horizontal piping.

J. Provide copper plated hangers and supports for copper piping.

K. Design hangers for pipe movement without disengagement of supported pipe.

L. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

3.05 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

D. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling and roof as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
   c. Pack void with backing material.
   d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

E. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition, floor, ceiling and roof opening as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
   c. Install type of firestopping material recommended by manufacturer.

2. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

3.06 FIELD QUALITY CONTROL

A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.07 CLEANING

A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.08 PROTECTION OF FINISHED WORK

A. Division 01 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect adjacent surfaces from damage by material installation.

3.09 SCHEDULES

PIPE HANGER SPACING		
PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
Cast Iron (All Sizes)	5	5/8
Cast Iron (All Sizes) with 10 foot length of pipe	10	5/8
Copper Tube, 1-1/4 inches and smaller	6	1/2
Copper Tube, 1-1/2 inches and larger	10	1/2
Steel, 3 inches and smaller	12	1/2
Steel, 4 inches and larger	12	5/8

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Sections:

1. Division 09 - Painting and Coating: Execution requirements for painting specified by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturers catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.05 QUALITY ASSURANCE

A. Conform to NFPA 99 requirements for labeling and identification of medical gas piping systems and accessories.

B. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

C. Maintain one copy of each document on site.

1.06 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.07 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.09 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two containers of spray-on adhesive.

PART 2 PRODUCTS

2.01 NAMEPLATES

A. Manufacturers:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Brady Co.
5. Substitutions: Division 01 - Product Requirements.

B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.02 TAGS

A. Metal Tags:

1. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges, supply with brass jack chain.

B. Information Tags:

1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.

C. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame.

2.03 STENCILS

A. Stencils: With clean cut symbols and letters of following size:

1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
4. Equipment: 1-3/4 inches high letters.

B. Stencil Paint: As specified in Division 09, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.04 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.05 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color-coded head.

B. Color code as follows:

1. Plumbing valves: Green.

2.06 LABELS

A. Description: Aluminum, size 1.9 x 0.75 inches, adhesive backed with printed identification.

2.07 LOCKOUT DEVICES

A. Lockout Hasps:

1. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

B. Valve Lockout Devices:

1. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Division 09 for stencil painting.

3.02 INSTALLATION

A. Apply stencil painting in accordance with Division 09.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Install piping identification on medical gas systems. Refer to Section 22 60 13.

H. Identify water heaters with plastic nameplates.

I. Identify control panels and major control components outside panels with plastic nameplates.

J. Identify valves in main and branch piping with tags.

K. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers or stenciled painting. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

L. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plumbing piping insulation, jackets and accessories.
2. Plumbing equipment insulation, jackets and accessories.

B. Related Sections:

1. Division 07 - Firestopping: Product requirements for firestopping for placement by this section.
2. Division 09 - Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.

1.02 REFERENCES

A. ASTM International:

1. ASTM C450 - Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
2. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
3. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
4. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
5. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

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

1.04 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Maintain one copy of each document on site.

1.05 QUALIFICATIONS

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

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience.

1.06 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for man made fiber.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:

1. CertainTeed.
2. Knauf.
3. Johns Manville.
4. Owens-Corning.
5. Substitutions: Division 01 - Product Requirements.

B. Manufacturers for Closed Cell Elastomeric Insulation Products:

1. Aeroflex. Aerocell.
2. Armacell, LLC. Armaflex.
3. Nomaco. K-flex.
4. Substitutions: Division 01 - Product Requirements.

2.02 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

B. TYPE P-5: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: Range: Minus 70 to 180 degrees F.

2.03 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.

E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with stainless steel jacket single piece construction with self adhesive closure. Thickness to match pipe insulation.

F. Adhesives: Compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify piping has been tested before applying insulation materials.

C. Verify surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Division 07 for penetrations of assemblies with fire resistance rating greater than one hour.

C. Hot Piping Systems less than 140 degrees F:

1. Furnish factory-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.

D. Inserts and Shields:

1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
   a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
   b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.

E. Insulation Terminating Points:

1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve.
2. Condensate Piping: Insulate entire piping system and components to prevent condensation.

F. Closed Cell Elastomeric Insulation:

1. Push insulation on to piping.
2. Miter joints at elbows.
3. Seal seams and butt joints with manufacturer's recommended adhesive.
4. When application requires multiple layers, apply with joints staggered.
5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

G. Prepare pipe insulation for finish painting. Refer to Division 09.

3.03 SCHEDULES

A. Water Supply Services Piping Insulation Schedule:

			Nominal Pipe Diameter (in inches)				
Fluid Temp. Range °F	**Conductivity Range (in BTU Inch Per Hour Per SF °F**	**Insulation Mean Rating Temp. °F**	**1 & Less**	**1.25-2**	**2.50-4**	**5-6**	**8 & Larger**
Service Water Heating Systems							
Above 105	0.24-0.28	100	1.0	1.0	1.5	1.5	1.5
Cooling Systems (Chilled Water & Refrigerant & Condensate Drain Lines)							
40-60	0.23-0.27	75	0.5	0.5	1.0	1.0	1.0
Below 40	0.23-0.27	75	1.0	1.0	1.5	1.5	1.5

END OF SECTION

SECTION 22 34 00

FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Commercial gas-fired water heaters.
2. Expansion tank.
3. Aquastats.
4. Timer switch.
5. Circulation pumps.

B. Related Sections:

1. Division 03 - Cast-In-Place Concrete: Execution requirements for concrete housekeeping pads specified by this section.
2. Section 22 07 00 - Plumbing Insulation: Field applied insulation for domestic water heaters.
3. Section 23 11 23 - Facility Natural-Gas Piping: Execution requirements for gas piping connections specified by this section.
4. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.02 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.10.1 - Gas Water Heaters Vol. I Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less.
2. ANSI Z21.10.3 - Gas Water Heaters - Vol. III Storage, with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous Water Heaters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. American Society of Mechanical Engineers:

1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate heater dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.

C. Product Data:

1. Water Heaters: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate capacity and power requirements. Submit electrical characteristics and connection locations.

D. Manufacturer's Installation Instructions: Submit mounting and support requirements.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.05 QUALITY ASSURANCE

A. Conform to ASME Section VIII for construction of water heaters. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.

B. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1 when tested in accordance with ANSI Z21.10.1 or ANSI Z21.10.3.

C. Maintain one copy of document on site.

1.06 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.07 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Products storage and handling requirements.

B. Accept water heaters on site in original labeled cartons. Inspect for damage.

C. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for domestic water heaters packaged water heating systems.

1.11 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two pump seals.

PART 2 PRODUCTS

2.01 COMMERCIAL GAS FIRED WATER HEATERS

A. Manufacturers:

1. A.O. Smith.
2. American Water Heater Group.
3. Bradford White.
4. Rheem.
5. Substitutions: Division 01 - Product Requirements.

B. Type: Automatic, natural gas-fired, vertical storage.

C. Capacity:

1. See Schedule.
2. Maximum working pressure: 150 psig.
3. Certification: ANSI Z21.10.1 or ANSI Z21.10.3.

D. Tank: Copper lined or Nickel (nickel/phosphorus) coating.

E. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

F. Approval: By AGA as automatic storage water heater.

2.02 DOMESTIC WATER EXPANSION TANK

A. Precharged welded steel tank with air charging valve and removable heavy duty butyl/ EPDM diaphragm or bladder separating water and air with a working pressure of 150 psig. All internal parts shall comply with FDA regulations and approvals. The tank shall have NPT stainless steel connection, gauge glass openings and drain and be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code. For model number see schedule on the drawings.

2.03 AQUASTATS

A. Provide immersed type adjustable volatile liquid mercury tube switch similar to Mercoid Type DA-37-2 Range 5 (I pole single), similar to Mercoid Type DA-37-127 Range 5 (2 pole duplex).

Set in oversized tee and nipple in hot water return line for automatically controlling hot water circulators and hot water circulating pumps.

2.04 TIME SWITCH

A. Provide an adjustable heavy duty self-starting synchronous motor clock (120 volt) in NEMA-1 enclosure for automatically controlling hot water circulators, hot water circulating pumps, distilled water booster pumps and demineralizer water booster pumps.

B. Clock shall have seven-day calendar dial, similar to Tork Series W and the number of poles as required.

2.05 ACCEPTABLE MANUFACTURERS - IN-LINE CIRCULATION PUMPS

A. Bell and Gossett, see schedules.

2.06 IN-LINE CIRCULATION PUMPS

A. All bronze construction body, stainless steel face plate, 30% glass filled Noryl impeller, carbon steel shaft, stainless steel shaft sleeve, mechanical, carbon on silicon carbide seal, sealed precision steel ball bearing permanently lubricated motor bearings, maximum operating pressure of 150 psi; 1/12 HP, 115 volts, 2650 rpm, non-overloading type motor, drip-proof. For model number see schedule on drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Maintain manufacturer's recommended clearances around and over water heaters.

B. Install water heater on concrete housekeeping pad, minimum 32 inches high and 6 inches larger than water heater base on each side. Refer to Division 03.

C. Connect natural gas piping in accordance with NFPA 54.

D. Connect domestic hot water and domestic cold water piping to supply and return water heater connections.

E. Install the following piping accessories. Refer to Section 22 11 00.

1. On supply:
   a. Thermometer well and thermometer.

2. On return:
   a. Thermometer well and thermometer.
   b. Shutoff valve.

F. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23.

G. Install discharge piping from relief valves and drain valves to nearest floor sink.

H. Install circulator and diaphragm expansion tank on water heater as indicated on the drawings.

I. Install water heater trim and accessories furnished loose for field mounting.

J. Install electrical devices furnished loose for field mounting.

K. Install control wiring between water heater control panel and field mounted control devices.

L. Connect flue to water heater outlet, full size of outlet. Refer to Section 23 51 00.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Water closets.
2. Urinals.
3. Lavatories.
4. Sinks.
5. Kitchen sinks.
6. Insulation kit.
7. Drinking fountain.
8. Mop sinks.
9. Floor drains.
10. Floor sinks.
11. Water hammer arrestors.
12. Trap primers.
13. Hose bibbs.
14. Access panels.
15. Cleanouts.
16. Roof drain.
17. Roof overflow drain.
18. Roof receptor.

B. Related Sections:

1. Division 07 - Joint Protection: Product requirements for calking between fixtures and building components for placement by this section.
2. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections to sensor valves and faucets specified by this section.

1.02 REFERENCES

A. American National Standards Institute:

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

B. Air-Conditioning and Refrigeration Institute:

1. ARI 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.

C. American Society of Mechanical Engineers:

1. ASME A112.6.1 - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
2. ASME A112.18.1 - Plumbing Fixture Fittings.
3. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
4. ASME A112.19.2M - Vitreous China Plumbing Fixtures.

5. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
6. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Manufacturer's Installation Instructions: Submit installation methods and procedures.

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

1.04 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.05 QUALITY ASSURANCE

A. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and indicated.

B. Maintain one copy of each document on site.

1.06 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.07 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Product storage and handling requirements.

B. Accept fixtures on site in factory packaging. Inspect for damage.

C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.09 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for plumbing fixtures.

1.10 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two sets of faucet washers, flush valve service kits, and lavatory supply fittings.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS – FIXTURES

A. American Standard

B. Kohler

C. Eljer

2.02 ACCEPTABLE MANUFACTURERS - FLUSH VALVES

A. Sloan

2.03 ACCEPTABLE MANUFACTURERS - WATER CLOSET SEATS

A. Olsonite

B. Beneke

C. Church

2.04 ACCEPTABLE MANUFACTURERS - FIXTURE CARRIERS

A. J.R. Smith

B. Zurn

C. Josam

2.05 ACCEPTABLE MANUFACTURERS - FIXTURE TRIM

A. Chicago Faucet

2.06 ACCEPTABLE MANUFACTURERS - MIXING VALVES (PRESSURE BALANCED)

A. Symmons

B. Leonard

C. Powers

2.07 ACCEPTABLE MANUFACTURERS – DRINKING FOUNTAIN

A. Sunroc

B. Haws

C. Elkay

D. Zurn

E. Josam

2.08 ACCEPTABLE MANUFACTURERS - FLOOR DRAINS

A. J.R. Smith

B. Zurn

C. Josam

2.09 ACCEPTABLE MANUFACTURERS - FLOOR SINKS

A. J.R. Smith

B. Zurn

C. Josam

2.10 ACCEPTABLE MANUFACTURERS - WATER HAMMER ARRESTORS

A. J.R. Smith

B. Zurn

C. Josam

2.11 ACCEPTABLE MANUFACTURERS - TRAP PRIMERS

A. J.R. Smith

B. Zurn

C. Josam

2.12 ACCEPTABLE MANUFACTURERS - HOSE BIBBS

A. Acorn

B. Woodford

C. Josam

2.13 ACCEPTABLE MANUFACTURERS - CLEANOUTS

A. J.R. Smith

B. Zurn

C. Josam

2.14 ACCEPTABLE MANUFACTURERS - ROOF DRAINS

A. J.R. Smith

B. Zurn

C. Josam

2.15 ACCEPTABLE MANUFACTURERS - OVERFLOW DRAINS

A. J.R. Smith

B. Zurn

C. Josam

2.16 ACCEPTABLE MANUFACTURERS - ROOF RECEPTOR

A. J.R. Smith

B. Zurn

C. Josam

2.17 WATER CLOSET, WALL HUNG, NORMAL / ACCESSIBLE

A. Bowl: ANSI A112.19.2; siphon jet, vitreous china closet bowl with elongated rim and 1-1/2" spud. For model number see schedule on drawings.

B. Flush Valve: ANSI A112.19.2; exposed chrome plated, 1.25 gallon per flush gallon per flush diaphragm type with oscillating handle, escutcheon, vacuum breaker. For model number see schedule on drawings.

C. Seat: Solid elongated plastic open front with self-sustaining hinge, brass bolts. For model number see schedule on drawings.

D. Wall Mounted Carrier: ANSI A112.19.1; cast iron and steel frame, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs. For model number see schedule on drawings.

2.18 URINAL, WALL HUNG, NORMAL / ACCESSIBLE

A. Urinal: ANSI A112.19.2; vitreous china, 1/8 gallon per flush, siphon jet with flushing rim, integral trap, 3/4 inch top spud. For model number see schedule on drawings. For mounting heights refer to Architectural drawings.

B. Flush Valve: ANSI A112.18.1; exposed chrome plated, diaphragm type with oscillating handle, escutcheon, vacuum breaker. For model number see schedule on drawings.

C. Wall Mounted Carrier: ANSI A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs. For model number see schedule on drawings.

2.19 LAVATORY, WALL HUNG, ACCESSIBLE

A. Basin: ANSI A112.19.2; vitreous china lavatory with 4 inch high back, drillings for 4 inch centers, and rectangular basin with splash lip front overflow. For model number see schedule on drawings.

B. Trim: ANSI A112.18.1; chrome plated manually operated faucet and strainer, chrome plated 17 gage L.A. pattern cast brass P-trap and arm with secured escutcheon and rigid supplies. For model number see schedule on drawings.

C. Wall Mounted Carrier: ANSI A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, concealed arm supports, bearing plate and studs. For model number see schedule on drawings.

2.20 LAVATORY, COUNTER TOP, ACCESSIBLE

A. Basin: ANSI A112.19.2; vitreous china unglazed rim for under counter mount, oval basin with front overflow. For model number see schedule on drawings.

B. Trim: ANSI A112.18.1; chrome plated manually operated faucet and strainer, chrome plated 17 gage L.A. pattern cast brass P-trap and arm with escutcheon, and rigid supplies. For model number see schedule on drawings.

2.21 INSULATION KIT

A. Where lavatories or sinks are noted to be insulated for ADA compliance, furnish the following: Safety covers conforming to ANSI A177.1, ASTM E84-07 and consisting of insulation kit of molded closet cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves and supply piping. Furnish with weep hole and angle valve access covers.

2.22 SINK, SINGLE COMPARTMENT, ACCESSIBLE

A. Bowl: ANSI A112.19.3; 6-1/2 inch deep bowl, 18 gage thick, Type 304 stainless steel, self-rimming with undercoating, single hole punching, 3-1/2 inch strainer, ledgeback drilled for trim. For model number see schedule on drawings.

B. Trim: ANSI A112.18.1; chrome plated gooseneck spout fitting. Chrome plated 17 gage L.A. pattern cast brass P-trap and arm with escutcheon and supplies. For model number see schedule on drawings.

2.23 SINK, DOUBLE COMPARTMENT, ACCESSIBLE

A. Bowl: ANSI A112.19.3; 18 gage thick, 6-1/2" deep bowl, Type 304 stainless steel, self-rimming with undercoating, three hole punching, 3-1/2 inch strainer on right and strainer on left bowl, ledgeback drilled for trim, disposer under right bowl. For model number see schedule on drawings.

B. Trim: ANSI A112.18.1; chrome plated gooseneck spout. Chrome plated 17 gage L.A. Pattern cast brass P-trap and arm with escutcheon, rigid supplies. For model number see schedule on drawings.

2.24 DRINKING FOUNTAIN

A. Fountain: Stainless steel wall-mounted, Hi-Low type accessible, vandal-resistant bubbler with push bar action and 1-1/4 inch P-trap. For model number see schedule on drawings.

2.25 MOP SINK, FLOOR MOUNTED

A. Bowl: Enameled cast iron, with 3" IPS drain and flat chrome strainer and vinyl rim guard. For model number see schedule on drawings.

B. Trim: ANSI A112.18.1; chrome plated fitting with vacuum breaker, pail hook and hose thread outlet. For model number see schedule on drawings.

2.26 ACCESS PANELS

A. 12" x 12" No. 4 finish stainless steel flush type, locate and set after review. Steel door and frame with metal flange with concealed hinges and screwdriver operated stainless steel cam lock. Karp style DSC-214M for fire rated construction use KRP-150FR with ring turn lock.

2.27 CLEANOUTS

A. Exterior Surfaced Areas C.O.Y.B.: Round cast nickel bronze access frame and non-skid cover; see Schedule on drawings for Model number.

B. Exterior Unsurfaced Areas G.C.O.: Line type with lacquered cast iron body and round epoxy coated gasketted cover; see Schedule on drawings for Model number.

C. Interior Finished Floor Areas F.C.O.: Lacquered cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar and adjustable nickel-bronze strainer, round with scoriated cover in service areas and round with depressed cover to accept floor finish in finished floor areas; see Schedule on drawings for Model number.

D. Interior Finished Wall Areas W.C.O.: Line type with lacquered cast iron body and round epoxy coated gasketted cover and round stainless steel access cover secured with machine screw; see Schedule on drawings for Model number.

2.28 FLOOR DRAINS

A. ANSI A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, round, adjustable polished nickel-bronze strainer; and trap primer connection; see Schedule on drawings for Model number.

2.29 FLOOR SINKS

A. Square lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, clamp collar and nickel bronze frame; see Schedule on drawings for Model number.

2.30 TRAP PRIMERS

A. ANSI A112.26; manuak type, cast bronze with 1/2-inch connection. See Schedule on drawings for Model number.

B. Electroic type, provide a trap primer enclosed in a 12" x 12" x 4" NEMA-1 enclosure, with a 1/2" inch NPT female inlet complying with ANSI/ASME BI.20.1, outlet shall be 1/2" inch compression fitting, provide with circuit breaker, switch, timer, manual override, solenoid valve marked as UL Listed, electronic assembly tested and certified per UL #73, and backflow device anti-siphon atmospheric vacuum breaker IAPMO, ASSE 1001 and CSA. Provide in accordance with ASSE Standard No. 1018. See schedule on the drawings for model number.

2.31 HOSE BIBBS

A. Provide recessed box, having one piece cast construction, stainless steel wall flange with a satin finish. The door shall be provided with a cam lock. Valves shall be cast bronze, exposed parts chrome-plated, tamper resistant lockshield bonnet and replaceable cartridge, ¾ inch inlet for cold, and ¾ inch outlet with vacuum breaker, See Schedules for Model No.

2.32 ACCEPTABLE MANUFACTURERS - ROOF DRAINS

A. ANSI A112.21.2; lacquered cast iron body with sump, removable cast iron dome strainer, membrane flange and membrane clamp with integral gravel stop with adjustable underdeck clamp roof sump receiver waterproofing flange leveling frame adjustable extension sleeve (for insulation) or perforated or slotted ballast guard extension for inverted roof; see Schedule on drawings for Model number.

2.33 ACCEPTABLE MANUFACTURERS - OVERFLOW DRAINS

A. Lacquered cast iron body and clamp collar and bottom clamp ring; cast iron dome; pipe extended to 2 inches above flood elevation; see Schedule on drawings for Model number.

2.34 ACCEPTABLE MANUFACTURERS - ROOF RECEPTOR

A. ANSI A112.21.1; roof receptor, cast iron with large sump and flange, no-hub outlet, removable dome and sediment cup, 2 inches high solid water dam, non-puncturing flashing clamp device integral with gravel stop, sump receiver and underdeck clamp; see Schedule on drawings for Model number.

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify walls and floor finishes are prepared and ready for installation of fixtures.

C. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall carriers and bolts.

E. Seal fixtures to wall and floor surfaces with sealant as specified in Division 07, color to match fixture.

F. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

G. For ADA accessible water closets, install flush lever with handle to wide side of stall.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.05 ADJUSTING

A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

A. Division 01 - Execution and Closeout Requirements: Final cleaning.

B. Clean plumbing fixtures and equipment.

3.07 PROTECTION OF INSTALLED CONSTRUCTION

A. Division 01 - Execution and Closeout Requirements: Protecting installed construction.

B. Do not permit use of fixtures before final acceptance.

END OF SECTION

SECTION 23 05 16

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Flexible pipe connectors.
   2. Expansion joints.
   3. Expansion compensators.
   4. Pipe alignment guides.
   5. Swivel joints.
   6. Pipe anchors.

B. Related Sections:
   1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for piping hangers and supports.
   2. Section 23 21 13 - Hydronic Piping: Product and installation requirements for piping used in hydronic heating and cooling systems.
   3. Section 23 23 00 - Refrigerant Piping: Product and installation requirements for piping used in refrigeration systems.

1.02 REFERENCES

A. American Society of Mechanical Engineers:
   1. ASME B31.1 - Power Piping.
   2. ASME B31.5 - Refrigeration Piping.
   3. ASME B31.9 - Building Services Piping.
   4. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. American Welding Society:
   1. AWS D1.1 - Structural Welding Code - Steel.

1.03 DESIGN REQUIREMENTS

A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.

B. Expansion Compensation Design Criteria:
   1. Installation Temperature: 50 degrees F.
   2. Hot Water Heating System Temperature: 210 degrees F.
   3. Safety Factor: 30 percent.

1.04 SUBMITTALS

A. Division 01 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints. Submit shop drawings sealed by a registered professional engineer. Include shop drawing information for piping expansion compensation in shop drawings for piping system specified.

C. Product Data:
   1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

D. Design Data: Indicate criteria and show calculations. Submit calculations sealed by a registered professional engineer.

E. Manufacturer's Installation Instructions: Submit special procedures.

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

G. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.05 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Operation and Maintenance Data: Submit adjustment instructions.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.1 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Perform Work in accordance with State of California Public Work's standard.

C. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of California.

1.08 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Product storage and handling requirements.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.10 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for leak free performance of packed expansion joints.

1.11 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Supply two 12 ounce containers of packing lubricant and cartridge style grease gun.

PART 2 PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS

A. Manufacturers:
   1. FLexonics.
   2. Metraflex.
   3. Substitutions: Division 01 - Product Requirements.

B. Steel Piping:
   1. Inner Hose: Stainless Steel.
   2. Exterior Sleeve: Double braided, stainless steel.
   3. Pressure Rating: 125 psig WSP and 45 degrees F and 200 psig WOG and 250 degrees F.
   4. Joint: Flanged.
   5. Size: Use pipe-sized units.
   6. Maximum offset: 3/4 inch on each side of installed center line.

C. Copper Piping:
   1. Inner Hose: Bronze.
   2. Exterior Sleeve: Braided bronze.
   3. Pressure Rating: 125 psig WSP and 45 degrees F and 200 psig WOG and 250 degrees F.
   4. Joint: Flanged.
   5. Size: Use pipe sized units.
   6. Maximum offset: 3/4 inch on each side of installed center line.

2.02 ACCESSORIES

A. Manufacturers:
   1. B-Line.
   2. Substitutions: Division 01 - Product Requirements.

B. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

C. Swivel Joints: Fabricated steel body, double ball bearing race, field lubricated, with o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install Work in accordance with ASME B31.1.

B. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Refer to Section 23 05 48. Provide line size flexible connectors.

C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

D. Rigidly anchor pipe to building structure. Provide pipe guides to direct movement only along axis of pipe. Erect piping so strain and weight is not on cast connections or apparatus.

E. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 23 05 29 for pipe hanger installation requirements.

F. Install Work in accordance with State of California Public Work's]standards.

3.02 MANUFACTURER'S FIELD SERVICES

A. Division 01 - Quality Requirements: Manufacturers' field services.

B. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment curbs.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel.
9. Firestopping accessories.
10. Equipment bases and supports.
11. See Contract Drawings for seismic bracing of ductwork, piping and equipment.

B. Related Sections:

1. Division 03 - Concrete Forming and Accessories: Execution requirements for placement of inserts in concrete forms specified by this section.
2. Division 03 - Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
3. Division 07 - Firestopping: Product requirements for firestopping for placement by this section.
4. Division 07 - Joint Protection: Product requirements for sealant materials for placement by this section.
5. Division 09- Painting and Coating: Product and execution requirements for painting specified by this section.
6. Section 23 21 13 - Hydronic Piping: Execution requirements for placement of hangers and supports specified by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.5 - Refrigeration Piping.
2. ASME B31.9 - Building Services Piping.

B. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

C. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

C. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit sizing methods or calculations sealed by a registered professional engineer.

E. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.

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

1.04 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.05 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.07 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.08 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for pipe hangers and supports.

PART 2 PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. B-Line Systems.
2. Anvil.
3. Tolco.

B. Hydronic Piping:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 4 Inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

15. Copper Pipe Support: Copper-plated, carbon steel ring.

C. Refrigerant Piping:

1. Conform to ASME B31.5.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated carbon-steel ring.

2.02 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.03 INSERTS

A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 FLASHING

A. Metal Flashing: 24 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing:

1. Waterproofing: 5 lb./sq. ft sheet lead.
2. Soundproofing: 1 lb./sq. ft sheet lead.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.05 EQUIPMENT CURBS

A. Fabrication: Welded 18 gage galvanized steel shell and base, mitered 3 inch cant, variable step to match roof insulation, 1-1/2 inch thick insulation, factory installed wood nailer.

2.06 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

E. Sealant: Refer to Division 07.

2.07 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation.
3. Substitutions: Division 01 - Product Requirements.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.08 FORMED STEEL CHANNEL

A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. B-Line Systems.
3. Midland Ross Corporation, Electrical Products Division.
4. Unistrut Corp.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

PART 3 EXECUTION

3.01 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.02 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.5 and ASME 31.9.

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support vertical piping at every floor.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide packing between hanger or support and piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Refer to Division 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

3.03 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment and/or anchorage attachment to pad. Refer to Division 03.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members, formed steel channel and steel pipe and fittings. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.04 INSTALLATION - FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.

C. Provide curbs for roof installations 8 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.

D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.05 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing, firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install chrome plated steel escutcheons at finished surfaces.

3.06 FIELD QUALITY CONTROL

A. Division 01 - Quality Requirements and Execution and Closeout Requirements. Field inspecting, testing, adjusting, and balancing.

B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.07 CLEANING

A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.

3.08 PROTECTION OF FINISHED WORK

A. Division 01 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect adjacent surfaces from damage by material installation.

3.09 SCHEDULES

A. Maximum Copper and Steel Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
1/2	5	7	3/8	3/8
3/4	5	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
2-1/2 (Note 2)	9	11	1/2	1/2
3	10	12	1/2	1/2
4	12	14	1/2	5/8
5	13	16	1/2	5/8
6	14	17	5/8	3/4
8	16	19	3/4	3/4
10	18	22	3/4	7/8
12	19	23	3/4	7/8
14	22	25	7/8	1
16	23	27	7/8	1
18	25	28	1	1
20	27	30	1	1-1/4
24	28	32	1-1/4	1-1/4

B. Maximum Plastic and Ductile Iron Pipe Hanger Spacing:

PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
ABS (All sizes)	4	3/8
FRP (All Sizes)	4	3/8
Ductile Iron (Note 2)		
PVC (All Sizes)	4	3/8

C. Note 1: Refer to manufacturer's recommendations for grooved end piping systems.

D. Note 2: 20 feet maximum spacing, minimum of one hanger for each pipe section close to joint behind bell. Provide hanger at each change of direction and each branch connection. For pipe sizes 6 inches and smaller, subjected to loadings other than weight of pipe and contents, limit span to maximum spacing for water service steel pipe.

3.10 SEISMIC BRACING

A. Provide seismic bracing of pipe, ductwork and equipment for SMACNA Seismic Restraint Manual Guidelines in accordance with CBC, and ASCE requirements. See Contractor Drawings for additional details.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Sections:

1. Division 09 - Painting and Coating: Execution requirements for painting specified by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturers catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Samples: Submit two tags, labels, pipe markers and size used on project.

E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

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

1.04 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.05 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

B. Maintain one copy of each document on site.

1.06 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.07 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.09 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.01 NAMEPLATES

A. Manufacturers:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.

B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.02 TAGS

A. Plastic Tags:

1. Manufacturers:
   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter.

B. Metal Tags:

1. Manufacturers:
   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.

2. Stainless Steel with stamped letters; tag size minimum 1-1/2 inches diameter or square with finished edges.

C. Information Tags:

1. Manufacturers:
   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.

2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.

2.03 STENCILS

A. Manufacturers:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.

B. Stencils: With clean cut symbols and letters of following size:

1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
4. Ductwork and Equipment: 1-3/4 inches high letters.

C. Stencil Paint: As specified in Division 09, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.04 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers:

1. Manufacturers:
   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:

1. Manufacturers:
   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.

2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Plastic Underground Pipe Markers:

1. Manufacturers:
   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.

2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.05 CEILING TACKS

A. Manufacturers:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.

B. Description: Steel with 3/4 inch diameter color-coded head.

C. Color code as follows:

1. HVAC equipment: Yellow.
2. Fire dampers/smoke dampers: Red.
3. Plumbing valves: Green.
4. Heating/cooling valves: Blue.

2.06 LABELS

A. Manufacturers:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.

B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Division 09 for stencil painting.

3.02 INSTALLATION

A. Apply stencil painting in accordance with Division 09.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with stainless steel nameplates, stencil painting. Identify in-line pumps and other small devices with tags.

H. Identify control panels and major control components outside panels with plastic nameplates.

I. Identify valves in main and branch piping with tags.

J. Identify air terminal units and radiator valves with numbered tags.

K. Tag automatic controls, instruments, and relays. Key to control schematic.

L. Identify piping, concealed or exposed, with plastic pipe markers, stenciled painting. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

M. For exposed natural gas lines other than steel pipe, attach yellow pipe labels with "GAS" in black lettering, at maximum 5 foot spacing.

N. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

O. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.03 SCHEDULES

A. Identification: Shall be per ANSI Standard.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Testing adjusting and balancing of air systems.
2. Testing adjusting and balancing of hydronic systems.
3. Measurement of final operating condition of HVAC systems.
4. Sound measurement of equipment operating conditions.
5. Vibration measurement of equipment operating conditions.
6. Verification of fire/smoke damper operation.

1.02 REFERENCES

A. Associated Air Balance Council:

1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

C. Natural Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Prior to commencing Work, submit proof of latest calibration date of each instrument.

C. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms.

D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

E. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty.

F. Submit draft copies of report for review prior to final acceptance of Project.

G. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.04 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of flow measuring stations of balancing valves and rough setting.

C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance.

B. Maintain one copy of each document on site.

C. Prior to commencing Work, calibrate each instrument to be used.

1.06 QUALIFICATIONS

A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum years documented experience certified by AABC.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer.

1.07 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

1.08 SEQUENCING

A. Division 01 - Summary: Work sequence.

B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.09 SCHEDULING

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Schedule and provide assistance in final adjustment and test of life safety system with Fire Authority.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify systems are complete and operable before commencing work. Verify the following:

1. Systems are started and operating in safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place or in normal position.
15. Service and balancing valves are open.

3.02 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations.

B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.03 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design.

B. Air Outlets and Inlets: Adjust total to within plus 5 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.04 ADJUSTING

A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Verify recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

E. Report defects and deficiencies noted during performance of services, preventing system balance.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.05 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries.

3.06 WATER SYSTEM PROCEDURE

A. Adjust water systems, after air balancing, to obtain design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.

C. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

3.07 FIRE/SMOKE DAMPERS

A. Provide field verification of fire/smoke damper per code requirement including, but not limited to, the following:

1. Visual confirmation of the complete closure of the dampers when the fire/alarm system is in simulated fire modes and during power simulated power failure.
2. Visual confirmation that the dampers are fully open during normal modes without any unusual noise and vibrations.

3.08 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:

1. Plumbing Pumps.
2. HVAC Pumps.
3. Copper Tube Boilers.
4. Closed Circuit Cooling Tower.
5. Computer Room Split System Units.
6. Wter Source Heat Pump Units.
7. Fans.
8. Air Filters.
9. Air Inlets and Outlets.

B. Report Forms

1. Title Page:
   a. Name of Testing, Adjusting, and Balancing Agency
   b. Address of Testing, Adjusting, and Balancing Agency
   c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
   d. Project name
   e. Project location
   f. Project Architect
   g. Project Engineer
   h. Project Contractor
   i. Project altitude
   j. Report date

2. Summary Comments:
   a. Design versus final performance
   b. Notable characteristics of system

c. Description of systems operation sequence
d. Summary of outdoor and exhaust flows to indicate building pressurization
e. Nomenclature used throughout report
f. Test conditions

3. Instrument List:
   a. Instrument
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Range
   f. Calibration date

4. Electric Motors:
   a. Manufacturer
   b. Model/Frame
   c. HP/BHP and kW
   d. Phase, voltage, amperage; nameplate, actual, no load
   e. RPM
   f. Service factor
   g. Starter size, rating, heater elements
   h. Sheave Make/Size/Bore

5. V-Belt Drive:
   a. Identification/location
   b. Required driven RPM
   c. Driven sheave, diameter and RPM
   d. Belt, size and quantity
   e. Motor sheave diameter and RPM
   f. Center to center distance, maximum, minimum, and actual

6. Pump Data:
   a. Identification/number
   b. Manufacturer
   c. Size/model
   d. Impeller
   e. Service
   f. Design flow rate, pressure drop, BHP and kW
   g. Actual flow rate, pressure drop, BHP and kW
   h. Discharge pressure
   i. Suction pressure
   j. Total operating head pressure
   k. Shut off, discharge and suction pressures
   l. Shut off, total head pressure

7. Combustion Test:
   a. Manufacturer
   b. Model number
   c. Serial number
   d. Firing rate
   e. Overfire draft
   f. Gas meter timing dial size
   g. Gas meter time per revolution
   h. Gas pressure at meter outlet

i. Gas flow rate
j. Heat input
k. Burner manifold gas pressure
l. Percent carbon monoxide (CO)
m. Percent carbon dioxide (CO2)
n. Percent oxygen (O2)
o. Percent excess air
p. Flue gas temperature at outlet
q. Ambient temperature
r. Net stack temperature
s. Percent stack loss
t. Percent combustion efficiency
u. Heat output

8. Cooling Tower:
   a. Tower identification/number
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Rated capacity
   f. Entering air WB temperature, specified and actual
   g. Leaving air WB temperature, specified and actual
   h. Ambient air DB temperature
   i. Condenser water entering temperature
   j. Condenser water leaving temperature
   k. Condenser water flow rate
   l. Fan RPM

9. Cooling Coil Data:
   a. Identification/number
   b. Location
   c. Service
   d. Manufacturer
   e. Air flow, design and actual
   f. Entering air DB temperature, design and actual
   g. Entering air WB temperature, design and actual
   h. Leaving air DB temperature, design and actual
   i. Leaving air WB temperature, design and actual
   j. Water flow, design and actual
   k. Water pressure drop, design and actual
   l. Entering water temperature, design and actual
   m. Leaving water temperature, design and actual
   n. Saturated suction temperature, design and actual
   o. Air pressure drop, design and actual

10. Heating Coil Data:
    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Air flow, design and actual
    f. Water flow, design and actual
    g. Water pressure drop, design and actual
    h. Entering water temperature, design and actual

i. Leaving water temperature, design and actual
j. Entering air temperature, design and actual
k. Leaving air temperature, design and actual
l. Air pressure drop, design and actual

11. Air Moving Equipment:
    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Arrangement/Class/Discharge
    f. Air flow, specified and actual
    g. Return air flow, specified and actual
    h. Outside air flow, specified and actual
    i. Total static pressure (total external), specified and actual
    j. Inlet pressure
    k. Discharge pressure
    l. Sheave Make/Size/Bore
    m. Number of Belts/Make/Size
    n. Fan RPM

12. Return Air/Outside Air Data:
    a. Identification/location
    b. Design air flow
    c. Actual air flow
    d. Design return air flow
    e. Actual return air flow
    f. Design outside air flow
    g. Actual outside air flow
    h. Return air temperature
    i. Outside air temperature
    j. Required mixed air temperature
    k. Actual mixed air temperature
    l. Design outside/return air ratio
    m. Actual outside/return air ratio

13. Exhaust Fan Data:
    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Air flow, specified and actual
    f. Total static pressure (total external), specified and actual
    g. Inlet pressure
    h. Discharge pressure
    i. Sheave Make/Size/Bore
    j. Number of Belts/Make/Size
    k. Fan RPM

14. Duct Traverse:
    a. System zone/branch
    b. Duct size
    c. Area
    d. Design velocity

e. Design air flow
f. Test velocity
g. Test air flow
h. Duct static pressure
i. Air temperature
j. Air correction factor

15. Duct Leak Test:
    a. Description of ductwork under test
    b. Duct design operating pressure
    c. Duct design test static pressure
    d. Duct capacity, air flow
    e. Maximum allowable leakage duct capacity times leak factor
    f. Test apparatus
        1) Blower
        2) Orifice, tube size
        3) Orifice size
        4) Calibrated
    g. Test static pressure
    h. Test orifice differential pressure
    i. Leakage

16. Air Monitoring Station Data:
    a. Identification/location
    b. System
    c. Size
    d. Area
    e. Design velocity
    f. Design air flow
    g. Test velocity
    h. Test air flow

17. Flow Measuring Station:
    a. Identification/number
    b. Location
    c. Size
    d. Manufacturer
    e. Model number
    f. Serial number
    g. Design Flow rate
    h. Design pressure drop
    i. Actual/final pressure drop
    j. Actual/final flow rate
    k. Station calibrated setting

18. Air Distribution Test Sheet:
    a. Air terminal number
    b. Room number/location
    c. Terminal type
    d. Terminal size
    e. Area factor
    f. Design velocity
    g. Design air flow
    h. Test (final) velocity

i. Test (final) air flow
j. Percent of design air flow

19. Sound Level Report:
    a. Location
    b. Octave bands - equipment off
    c. Octave bands - equipment on
    d. RC level - equipment on

20. Vibration Test:
    a. Location of points:
        1) Fan bearing, drive end
        2) Fan bearing, opposite end
        3) Motor bearing, center (when applicable)
        4) Motor bearing, drive end
        5) Motor bearing, opposite end
        6) Casing (bottom or top)
        7) Casing (side)
        8) Duct after flexible connection (discharge)
        9) Duct after flexible connection (suction)
    b. Test readings:
        1) Horizontal, velocity and displacement
        2) Vertical, velocity and displacement
        3) Axial, velocity and displacement
    c. Normally acceptable readings, velocity and acceleration
    d. Unusual conditions at time of test
    e. Vibration source (when non-complying)

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. HVAC piping insulation, jackets and accessories.
2. HVAC equipment insulation, jackets and accessories.
3. HVAC ductwork insulation, jackets, and accessories.

B. Related Sections:

1. Division 07 - Firestopping: Product requirements for firestopping for placement by this section.
2. Division 09 - Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.

1.02 REFERENCES

A. ASTM International:

1. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
2. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
3. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
4. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
5. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
6. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
7. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
8. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
9. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
10. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
11. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
12. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
13. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
14. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
15. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
16. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

17. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
18. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
19. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

B. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. Underwriters Laboratories Inc.:

1. UL 1978 - Standard for Safety for Grease Ducts.

1.03 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C. Samples: Submit two samples of representative size illustrating each insulation type.

D. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Duct insulation, Coverings, and Linings: Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

1.05 QUALIFICATIONS

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

B. Applicator: Company specializing in performing Work of this section with minimum five years documented experience.

1.06 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

1.09 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:

1. CertainTeed.
2. Knauf.
3. Johns Manville.
4. Owens-Corning.

B. Manufacturers for Closed Cell Elastomeric Insulation Products:

1. Aeroflex. Aerocell.
2. Armacell, LLC. Armaflex.
3. Nomaco. K-flex.

C. Manufacturers for Polyisocyanurate Foam Insulation Products:

1. Dow Chemical Company.
2. Substitutions: Division 01 - Product Requirements.

D. Manufacturers for Extruded Polystyrene Insulation Products:

1. Dow Chemical Company.
2. Substitutions: Division 01 - Product Requirements.

2.02 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

B. TYPE P-2: ASTM C547, molded glass fiber pipe insulation.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.

C. TYPE P-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: 0 to 650 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

D. TYPE P-4: ASTM C612; semi-rigid, fibrous glass board noncombustible.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: 0 to 650 degrees F.

E. TYPE P-5: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: Range: Minus 70 to 180 degrees F.

F. TYPE P-6: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.30 at 75 degrees F.
2. Maximum Service Temperature: 300 degrees F.
3. Operating Temperature Range: Range: Minus 58 to 300 degrees F.

G. TYPE P-7: ASTM C534, Type I, flexible, nonhalogen, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Maximum Service Temperature: 250 degrees F.
3. Operating Temperature Range: Range: Minus 58 to 250 degrees F.

H. TYPE P-8: ASTM C547, Type I or II, mineral fiber preformed pipe insulation, noncombustible.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Maximum Service Temperature: 1200 degrees F.
3. Canvas Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric treated with fire retardant lagging adhesive.

I. TYPE P-11: ASTM C533; Type I, hydrous calcium silicate pipe insulation, rigid molded white; asbestos free.

1. Thermal Conductivity: 0.45 at 200 degrees F.
2. Operating Temperature Range: 140 to 1200 degrees F.

2.03 PIPE INSULATION JACKETS

A. Vapor Retarder Jacket:

1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.

B. PVC Plastic Pipe Jacket:

1. Product Description: ASTM D1785, One piece molded type fitting covers and sheet material, off-white color.
2. Thickness: 10 mil.
3. Connections: Brush on welding adhesive and tacks.

C. ABS Plastic Pipe Jacket:

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
2. Minimum service temperature: 0 degrees F.
3. Maximum service temperature of 180 degrees F.
4. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
5. Thickness: 30 mil.
6. Connections: Brush on welding adhesive.

D. Aluminum Pipe Jacket:

1. ASTM B209.
2. Thickness: 0.025 inch thick sheet.
3. Finish: Smooth.
4. Joining: Longitudinal slip joints and 2 inch laps with caulking.
5. Fittings: 0.025 inch thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 1/2 inch wide; 0.010 inch thick stainless steel.

2.04 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.

E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with stainless steel jacket single piece construction with self-adhesive closure. Thickness to match pipe insulation.

F. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

G. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

H. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

I. Adhesives: Compatible with insulation.

2.05 EQUIPMENT INSULATION

A. TYPE E-1: ASTM C553; glass fiber, flexible or semi-rigid, noncombustible.

1. Thermal Conductivity: 0.24 at 75 degrees F.
2. Operating Temperature Range: 0 to 450 degrees F.
3. Density: 1.5 pound per cubic foot.

B. TYPE E-2: ASTM C612; glass fiber, rigid board, noncombustible with factory applied kraft reinforced aluminum foil jacket.

1. Thermal Conductivity: 0.24 at 75 degrees F.
2. Operating Temperature Range: 0 to 450 degrees F.
3. Density: 3.0 pound per cubic foot.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

C. TYPE E-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: 0 to 650 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

D. TYPE E-4: ASTM C612; semi-rigid, fibrous glass board noncombustible.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: 0 to 650 degrees F.

E. TYPE E-5: ASTM C612; glass fiber, semi-rigid board, noncombustible.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Maximum Operating Temperature: 850 degrees F.
3. Density: 3.0 pound per cubic foot.

F. TYPE E-6: ASTM C553; mineral fiber blanket, Type I.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Maximum Operating Temperature: 1000 degrees F.
3. Density: 1.0 pound per cubic foot.

G. TYPE E-7: ASTM C533; Type II, hydrous calcium silicate block insulation, asbestos free.

1. Thermal Conductivity: 0.45 at 200 degrees F.

2. Operating Temperature Range: 140 to 1200 degrees F.

H. TYPE E-8: ASTM C534, Type II, flexible, closed cell elastomeric insulation, sheet.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: Range: Minus 70 to 220 degrees F.

I. TYPE E-9: ASTM C612, manmade mineral fiber, noncombustible, Classes 1-4.

1. Thermal Conductivity: 0.25 at 100 degrees F.
2. Maximum Service Temperature: 1200 degrees F.
3. Density: 6 pound per cubic foot.

2.06 EQUIPMENT INSULATION JACKETS

A. PVC Plastic Equipment Jacket:

1. Product Description: ASTM D1785, sheet material, off-white color.
2. Minimum Service Temperature: 0 degrees F.
3. Maximum Service Temperature: 150 degrees F.
4. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
5. Thickness: 20 mil.
6. Connections: Brush on welding adhesive and tacks.

B. Aluminum Equipment Jacket:

1. ASTM B209 Thickness: 0.025 inch thick sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 and 0.025 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

C. Canvas Equipment Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric with fire retardant lagging adhesive compatible with insulation.

D. Vapor Retarder Jacket:

1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.

2.07 EQUIPMENT INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

E. Adhesives: Compatible with insulation.

2.08 DUCTWORK INSULATION

A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.

1. Thermal Conductivity: 0.25 at 75 degrees F.
2. Maximum Operating Temperature: 250 degrees F.
3. Density: 1.5 pound per cubic foot.

B. TYPE D-2: ASTM C612, Type IA or IB, rigid glass fiber, with factory applied reinforced aluminum foil facing meeting ASTM C1136, Type II.

1. Thermal Conductivity: 0.22 at 75 degrees F.
2. Density: 3.0 pound per cubic foot.

C. TYPE D-4: ASTM C1071, Type I, flexible, glass fiber duct liner with coated air side.

1. Thermal Conductivity: 0.24 at 75 degrees F.
2. Density: 1.5 pound per cubic foot.
3. Maximum Operating Temperature: 250 degrees F.
4. Maximum Air Velocity: 6,000 feet per minute.

D. TYPE D-5: ASTM C1071, Type II, rigid, glass fiber duct liner with coated air side.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Density: 3.0 pound per cubic foot.
3. Maximum Operating Temperature: 250 degrees F.
4. Maximum Air Velocity: 4,000 feet per minute.

2.09 DUCTWORK INSULATION JACKETS

A. Exterior Ductwork: Provide dual wall ductwork with specified insulation per Section 23 321 00.

B. Vapor Retarder Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
3. Secure with pressure sensitive tape.

C. Canvas Duct Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric with fire retardant lagging adhesive compatible with insulation.

2.10 DUCTWORK INSULATION ACCESSORIES

A. Vapor Retarder Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

B. Vapor Retarder Lap Adhesive: Compatible with insulation.

C. Adhesive: Waterproof, ASTM E162 fire-retardant type.

D. Liner Fasteners: Galvanized steel, welded with press-on head.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F. Lagging Adhesive: Fire retardant type with maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.

H. Adhesives: Compatible with insulation.

I. Membrane Adhesives: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify piping, equipment and ductwork has been pressure tested before applying insulation materials.

C. Verify surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Division 07 for penetrations of assemblies with fire resistance rating greater than one hour.

C. Piping Systems Conveying Fluids Below Ambient Temperature:

1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.

D. Glass Fiber Board Insulation:

1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.

E. Hot Piping Systems less than 140 degrees F:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.

F. Hot Piping Systems greater than 140 degrees F:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
3. Insulate flanges and unions at equipment.

G. Inserts and Shields:

1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
   a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
   b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.

H. Insulation Terminating Points:

1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve.
2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
3. Condensate Piping: Insulate entire piping system and components to prevent condensation.

I. Closed Cell Elastomeric Insulation:

1. Push insulation on to piping.
2. Miter joints at elbows.
3. Seal seams and butt joints with manufacturer's recommended adhesive.
4. When application requires multiple layers, apply with joints staggered.
5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

J. High Temperature Pipe Insulation:

1. Install in multiple layers to meet thickness scheduled.
2. Attach each layer with bands. Secure first layer with bands before installing next layer.
3. Stagger joints between layers.
4. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

L. Piping Exterior to Building: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.

M. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

N. Prepare pipe insulation for finish painting. Refer to Division 09.

3.03 INSTALLATION - EQUIPMENT

A. Factory Insulated Equipment: Do not insulate.

B. Exposed Equipment: Locate insulation and cover seams in least visible locations.

C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.

D. Equipment Containing Fluids Below Ambient Temperature:

1. Insulate entire equipment surfaces.
2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
4. Finish insulation at supports, protrusions, and interruptions.

E. Equipment Containing Fluids 140 degrees F Or Less:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation.
2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
3. Finish insulation at supports, protrusions, and interruptions.

F. Equipment Containing Fluids Over 140 degrees F:

1. Insulate flanges and unions with removable sections and jackets.
2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
3. Finish insulation at supports, protrusions, and interruptions.

G. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.

H. Equipment Located Exterior to Building: Install vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.

I. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.

J. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

K. Prepare equipment insulation for finish painting. Refer to Division 09.

3.04 INSTALLATION - DUCTWORK SYSTEMS

A. Duct dimensions indicated on Drawings are finished inside dimensions.

B. Insulated ductwork conveying air below ambient temperature:

1. Provide insulation with vapor retarder jackets.
2. Finish with tape and vapor retarder jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated ductwork conveying air above ambient temperature:

1. Provide with or without standard vapor retarder jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

E. External Glass Fiber Duct Insulation:

1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
2. Secure insulation without vapor retarder with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

F. External Elastomeric Duct Insulation:

1. Adhere to clean oil-free surfaces with full coverage of adhesive.
2. Seal seams and butt joints with manufacturer's recommended adhesive.
3. When application requires multiple layers, apply with joints staggered.
4. Insulate standing metal duct seams with insulation of like material and thickness as adjacent duct surface. Apply adhesive at joints with flat duct surfaces.
5. Lift ductwork off trapeze hangers and insert spacers.

G. Duct and Plenum Liner:

1. Adhere insulation with adhesive for 100 percent coverage.
2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Cut insulation for tight overlapped corner joints. Support top pieces of liner at edges with side pieces.

H. Ducts Exterior to Building:

1. Install insulation according to schedule below.
2. Provide external insulation with vapor retarder jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
3. Calk seams at flanges and joints. Located major longitudinal seams on bottom side of horizontal duct sections.

I. Prepare duct insulation for finish painting. Refer to Division 09.

3.05 SCHEDULES

A. Cooling Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Condensate Piping from Cooling Coils	P-5	All sizes	0.5
Refrigerant Suction	P-5	All sizes	1.0
Refrigerant Hot Gas	P-5	All sizes	1.0

B. Heating Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Heating Water Supply and Return 141 to 200 degrees F	P-1		1.5

C. Ductwork Insulation Schedule:

DUCTWORK SYSTEM	INSULATION TYPE	INSULATION THICKNESS inches
Supply Ducts (internally insulated)	D-4, D-5	1.0
Return Ducts (internally insulated)	D-4, D-5	1.0
Supply Ducts (externally insulated)	D-1	1.5
Return Ducts (externally insulated)	D-1	1.5
Supply Air, Return Air (exterior to building on roof)	D-2, D-7	2.0
Transfer Air Ducts (internally insulated)	D-5	1.0

END OF SECTION

SECTION 23 08 00

COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Include in project schedule as maintained by contractor, sufficient duration prior to equipment startup, to coordinate related activities including but not limited to HVAC systems test and balance, and point-to-point verification of controls, that the Commissioning Authority may ensure personnel are available to witness and verify testing/start-up.

B. Section Includes:

1. HVAC commissioning description.
2. HVAC commissioning responsibilities.

C. Related Sections:

1. Division 01 – Commissioning.
2. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: For requirements and procedures concerning testing, adjusting, and balancing of mechanical systems.
3. Section 23 09 23 - Direct-Digital Control System for HVAC: Submittal, training, and programming requirements.
4. Section 23 33 00 - Air Duct Accessories: Product requirements for ductwork test holes.

1.02 REFERENCES

A. Associated Air Balance Council:

1. AABC - AABC Commissioning Guideline.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE Guideline 1 - The HVAC Commissioning Process.

1.03 COMMISSIONING DESCRIPTION

A. Commissioning for this project will be performed in three (3) phases:

1. Performed during the design phase with the Commissioning Authority, Architectural and Engineering team.
2. Performed during the equipment installation and start-up phase with the Commissioning Authority, Engineering team, Contractor, sub-contractors and trades, and further defined herein.
3. Performed on an ongoing basis after the project team has delivered the project to the Owner. Ongoing Commissioning will be the responsibility of the Maintenance and Operations team.

B. Commissioning activities of the Commissioning process, included but not limited to, delivery of all reports, documentation, testing and systems verification is the responsibility of the County's Commissioning Authority, in conjunction with and supported by the General Contractor,

subcontractor, and/or trade(s) responsible for the system and/or system components. The commissioning process does not in any way relieve or excuse the Contractor from participation in and fulfillment of their obligations as related to delivery and turnover for final acceptance of the equipment by the County as agreed to in the contract, and as outlined in Division 01, or diminish the role and obligations of the contractor, sub-contractor and/or trade(s) to complete all portions of the work as defined for substantial completion and turnover to the Owner.

C. Contractor responsibilities include but are not limited to:

1. All testing and start-up related activities of the mechanical and related controls equipment.
2. Functional testing for the purpose of verifying equipment / system performance.
3. Furnish qualified personnel to assist in all commissioning tests, including but not limited to any / all seasonal or programmed system schedule testing.
4. Completion and endorsement of pre-functional test checklists furnished by the Commissioning Authority, and reviewed by the County to ensure that equipment and systems as outlined in Division 15 are fully operational and ready for functional testing.
5. Furnish equipment, materials, and labor necessary to correct deficiencies found during the commissioning process in accordance with contract and equipment warranty requirements and obligations.
6. provide training for all installed systems. Coordinating with County personnel and the Commissioning Authority.

D. Equipment and Systems to Be Commissioned:

1. Pumps.
2. Cooling towers.
3. Boilers.
4. Piping systems.
5. Ductwork.
6. Variable frequency drives.
7. Split system air conditioning units.
8. Water source heat pump units.
9. Fans.
10. Chemical treatment systems.
11. Fire dampers.
12. Smoke dampers.
13. Indoor air quality.
14. Equipment sound control.
15. Equipment vibration control.
16. Kitchen hood supply systems.
17. Kitchen hood exhaust systems.
18. Automatic temperature control system.
19. Testing, Adjusting and Balancing work.

1.04 COMMISSIONING SUBMITTALS

A. Division 01 - Commissioning: Requirements for commissioning submittals.

B. Draft Forms: Submit draft of system verification form and functional performance test checklist.

C. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified. Use AABC forms as guidelines.

D. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.05 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.

C. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with AABC and ASHRAE Guideline 1.

B. Calibrated test and balance equipment shall be the responsibility of the Contractor.

1.07 COMMISSIONING RESPONSIBILITIES

A. Equipment or System Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Ensure temperature controls installer performs assigned commissioning responsibilities as specified below.
3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.
4. Provide instructions and demonstrations for Owner's personnel.
5. Ensure subcontractors perform assigned commissioning responsibilities.
6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
7. Develop startup and initial checkout plan using manufacturer's startup procedures and functional performance checklists for equipment and systems to be commissioned.
8. During verification check and startup process, execute HVAC related portions of checklists for equipment and systems to be commissioned.
9. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
10. Provide manufacturer's representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
12. Provide personnel to assist Commissioning Authority during equipment or system verification checks and functional performance tests.
13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
15. Provide factory supervised startup services for equipment and systems specified. Coordinate work with manufacturer and Commissioning Authority.

16. Perform verification checks and startup on equipment and systems as specified.
17. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.
18. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
19. Conduct HVAC system orientation and inspection.

B. Equipment specifically required for the commissioning process and not generally used in the startup of mechanical systems shall be furnished by the Commissioning Authority.

C. Any test equipment specific to a given manufacturer and required by the manufacturer for startup and/or maintenance of the equipment shall be furnished by the Contractor.

D. Contractor is responsible for the correct operation of manufacturer required or supplied specific equipment and shall include the description of and training related to said equipment in the project manual and demonstrate the correct use of this equipment during training of the Maintenance and Operations team.

E. Temperature Controls Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Review design for ability of systems to be controlled including the following:
    a. Confirm proper hardware requirements exists to perform functional performance testing.
    b. Confirm proper safeties and interlocks are included in design.
    c. Confirm proper sizing of system control valves and actuators and control valve operation will result capacity control identified in Contract Documents.
    d. Confirm proper sizing of system control dampers and actuators and damper operation will result in proper damper positioning.
    e. Confirm sensors selected are within device ranges.
    f. Review sequences of operation and obtain clarification from Architect/Engineer.
    g. Indicate delineation of control between packaged controls and building automation system, listing BAS monitor points and BAS adjustable control points.
    h. Provide written sequences of operation for packaged controlled equipment. Equipment manufacturers' stock sequences may be included, when accompanied by additional narrative to reflect Project conditions.
3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other HVAC sections.
4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Architect/Engineer.
5. Inspect check and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.
6. Perform training sessions to instruct Owner's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan and requirements of Section 23 09 23.
7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.
9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

F. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes. Repeat sample of 10 percent of measurements contained in testing, adjusting, and balancing report as selected by Commissioning Authority.
3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.08 COMMISSIONING MEETINGS

A. Division 01 - Commissioning: Requirements for commissioning meetings.

B. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.09 SCHEDULING

A. Division 01 - Administrative Requirements and Construction Progress Schedule.

B. Prepare schedule indicating anticipated start dates for the following:

1. Piping system pressure testing.
2. Piping system flushing and cleaning.
3. Ductwork cleaning.
4. Ductwork pressure testing.
5. Equipment and system startups.
6. Automatic temperature control system checkout.
7. Testing, adjusting, and balancing.
8. HVAC system orientation and inspections.
9. Operation and maintenance manual submittals.
10. Training sessions.

C. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.

D. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy or use.

1.10 COORDINATION

A. Division 01 - Administrative Requirements: Requirements for coordination.

B. Notify Commissioning Authority minimum of four weeks in advance of the following:

1. Scheduled equipment and system startups.
2. Scheduled automatic temperature control system checkout.
3. Scheduled start of testing, adjusting, and balancing work.

C. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

3.01 WORK PRIOR TO COMMISSIONING

A. Contractor shall complete all installation and startup.

B. Contractor is not responsible for Commissioning activities conducted during Phase I or Phase III Commissioning except where warranty work or corrective work is undertaken, in which case Contractor shall ensure that and all work done at that time is fully commissioned prior to acceptance by the County.

C. Contractor shall maintain a project schedule inclusive of time allowed for Commissioning activities.

D. Contractor shall immediately notify the Commissioning Authority of any updates to the installation schedule for mechanical equipment and related systems.

E. When requested by the Commissioning Authority, Contractor shall furnish technical specifications and details of the equipment to be installed for inclusion in the Commissioning plan.

F. F. Contractor shall:

1. Completely and fully install equipment as defined in the agreement.
2. Perform pre-functional testing of the equipment and systems documenting and verifying completed tests on start-up forms provided by the Commissioning Authority.
3. Identify equipment that will be started by the manufacturer and coordinate startup activities with Commissioning Authority so any required personnel may be present to document the process and outcome.

G. Commissioning activities may begin prior to the complete installation of a system or sub-system or at the completion of installation of a system or sub-system, at the direction of the Commissioning Authority.

H. A Field Commissioning Notebook will be used to identify and track all pertinent commissioning documentation required during the installation phase. This Notebook is the responsibility of the Commissioning Authority and shall be managed and maintained by the Contractor. The Notebook will be kept in the Contractor's trailer at the project site. Relevant information will be included in the following format:

1. Table of Contents
2. Overview
3. Copy of Commissioning Plan for Contractor field reference.
4. Tabs for each specification section with copies of pre-functional test check sheets furnished by Contractor or subcontractor and Commissioning Authority for Contractor completion and space for related Contractor-supplied documents and sign-offs.

3.02 INSTALLATION

A. Install additional balancing dampers, balancing valves, access doors, test ports, and pressure and temperature taps required by Commissioning Authority.

B. Place HVAC systems and equipment into full operation and continue operation during each working day of commissioning.

C. Install replacement sheaves and belts to obtain system performance, as requested by Commissioning Authority.

D. Install test holes in ductwork and plenums as requested by Commissioning Authority for taking air measurements.

E. Prior to start of functional performance test, install replacement filters in equipment as specified in individual section.

3.03 PARTICIPATION IN COMMISSIONING

A. Furnish skilled technicians to start up and debug all systems within the Division of work. Contractor shall ensure the qualified technician(s) are available and present during the specified times and are available to complete the necessary tests, adjustments, and/or problem solving activities.

B. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.

C. Commissioning Authority shall immediately notify Owner of any perceived deficiencies in the qualifications of skilled technicians provided by the Contractor.

3.04 WORK TO RESOLVE DEFICIENCIES

A. Faulty equipment, and/or deficient performance under varying loads will result in system deficiencies and performance less than design intent. Correction of the work shall be completed under the direction of the County's Representative, with input from the Contractor, equipment supplier, Engineer, and Commissioning Authority. The County's Representative will have the final authority to determine the extent of corrective action necessary to achieve performance and or design intent.

3.05 ADDITIONAL COMMISSIONING

A. Additional commissioning may be required after system adjustments and/or corrections. It is the responsibility of the Contractor, sub-contractor, trades, and Commissioning Authority to ensure that Commissioning is complete for each system and/or sub-system.

3.06 RECOMMISSIONING

A. After the initial commissioning is complete, there may be additional work required based on new or revised systems operation. This work is not described or included in this Section.

B. In the event new system components are added to an existing system after the initial commissioning is complete, it will remain the responsibility of the Contractor, sub-contractor, trades, and Commissioning Authority to ensure that the entire system is commissioned prior to being substantially complete.

3.07 TRAINING

A. The Contractor shall provide training for the County's Maintenance and Operations staff for each mechanical system and the related components. Training will first be conducted in a classroom setting, with system and component documentation and suitable classroom training aids, followed by failure mode simulation with the equipment in the field, so far as can be achieved without causing damage to the equipment and/or related systems. See Division 01 for training plan requirements.

B. Training will be according to the contractors commissioning plan and verified by the Commissioning Authority, taught by the equipment vendors, and the Contractor. The Contractor shall be responsible for instructing the County's staff on the commissioned system specifics for a given project.

3.08 SYSTEMS DOCUMENTATION

A. In addition to the requirements of Division 01, update Contract Documents to incorporate field changes and revisions to systems to reflect as-installed conditions. All drawings shall be red-lined and maintained by the Contractor in the site project trailer.

B. Maintain current shop drawings on the job site.

C. In addition to the stated requirements for operation and maintenance data, furnish one copy of equipment technical literature, operation and maintenance literature, and shop drawings to the Commissioning Authority as soon as they are available.

3.09 FUNCTIONAL AND PRE-FUNCTIONAL TEST CHECKLISTS

A. The test sheets are updated through the construction process and the Commissioning Authority may change the sheets as necessary according to the updated changes in equipment and/or construction documents.

B. The Contractor is bound by the performance obligations outlined in the agreement and as described in this Section.

C. In addition to providing completed pre-functional checklist, the Sub-Contractor will provide copies of the start-up report for each piece of commissioned equipment.

D. Make available upon request printouts of trend data with time stamp of at least 48 hours and submit prior to functional testing, it shall be a stored data base from the BMS. Pre-program and set up system to automatically store control system data from sensors, and controlled devices trend logs per 30 minute interval for the following:

1. All WSHP systems sensors, on/off status, Heating/Cooling demand, damper position
2. Exhaust system sensors, on/off status, damper position.
3. All Room temperatures sensors 30 minute intervals.

4. Room supply, return and/or exhaust cfm demand and actual.
5. Outside ambient temperature
6. Building pressures

END OF SECTION

SECTION 23 09 23

ENERGY MANAGEMENT SYSTEM (EMS)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Scope of work defined in this specification and shown on the Mechanical drawings.

B. System specifics:
   1. Furnish and install a County of Riverside compliant DDC Control System.
   2. Contractors shall have at least eight (8) years experience with LONmark.
   3. Contractor shall be certified as a Master Integrator and provide certification.

1.02 QUALITY ASSURANCE

A. The system shall be furnished, engineered, and installed by the manufacturers' locally authorized representative. The controls contractor shall have factory-trained technicians to provide instruction, routine maintenance, and emergency service. While on site during the installation period respond within 1 hour upon receipt of request. After the installation respond within 24 hours.

B. At the time of bid, all EMS Application Specific Controllers and Programmable Equipment Controllers shall be listed as follows:
   1. American Society for testing and materials, ASTM
   2. Institute of Electrical and Electronic Engineers, IEEE
   3. National Electrical Manufacturers Association, NEMA
   4. Underwriters Laboratory, UL 916 and 864 UDTZ
   5. FCC Regulation, Part 15, Section 156
   6. National Fire Protection Association, NFPA
   7. Local building codes

C. The Manufacturer of the EMS digital controllers shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). Product literature provided by the EMS digital controller manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar.

1.03 SUBMITTALS

A. Within sixty (60) days of contract award submit 6 complete sets of documentation including the following:
   1. Title sheet with drawing index, mechanical equipment schedule, symbols & cables legends.
   2. Site plan and floor plan drawings indicating proposed communication trunk & LAN routing, HVAC equipment, starters/VFD'S and EMS panel locations.
   3. System schematics, including:
      a. sequences of operation
      b. point names
      c. point addresses
      d. point to point wiring
      e. interface wiring diagrams
      f. panel layouts
      g. system riser diagrams
      h. Loop planning charts
      i. Field devices bill of material
      j. Panel devices bill of material
      k. Installation, wiring & piping details

4. Equipment data sheets for all controllers, PCs, gateways, valves, actuators, damper actuators, sensors and transmitters.

B. Upon project completion, submit operation and maintenance manuals, consisting of the following:
   1. Index sheet, listing contents in alphabetical order
   2. Manufacturer's equipment parts list of all functional components of the system, disk of system schematics, including wiring diagrams
   3. Description of sequence of operations
   4. As-Built interconnection wiring diagrams
   5. User's documentation containing product, system architectural and programming information.
   6. Trunk cable schematic showing remote electronic panel locations, and all trunk data
   7. List of connected data points, including panels to which they are connected and input/output devices (sensors, valves & actuators, etc.)
   8. Wiring routing diagrams
   9. Copy of the warranty letter
   10. Operating and maintenance cautions and instructions
   11. Recommended spare parts list

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

A. Siemens Apogee DDC Control System.

B. Or approved equal.

2.02 ENERGY MANAGEMENT SYSTEM (EMS)

The Energy Management System (EMS) shall be comprised of a network of fully open LONMARK compliant interoperable, stand-alone digital controllers. All hardware and software shall be of the manufacturers' latest hardware and software versions and revision levels.

A. Global Controllers for distributed system applications, databases and networking functions. Graphics, database & logic shall reside in the Global Controller.

B. Programmable Equipment Controllers (PEC'S) for control of primary mechanical systems and distributed system applications. Controllers shall be fully programmable to create custom control solutions.

C. Application Specific Controllers for control of water source heat pump, boilers, and other terminal equipment.

D. Graphical User Interface (GUI), which includes the hardware and software necessary for a user to interface with the control system and devices.

2.03 GLOBAL CONTROLLERS

A. The Global Controller shall be the AX JACE 6 and will provide the interface between the field control devices, and provide global supervisory control functions over the control devices connected to the Global Controller. It shall be capable of executing application control programs to provide:
   1. Calendar functions
   2. Scheduling
   3. Trending
   4. Alarm monitoring and routing
   5. Time synchronization

B. The Global Controller shall provide multiple, concurrent user access to the system. A Database resident on the Global Controller shall provide data access mechanism to read and write the data stored within it.

C. The Global Controller shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
   1. It shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, cell phone, alphanumeric paging/telephone/PDA or wide-area network.
   2. Alarm generation shall be selectable for different annunciation type and acknowledgement requirements.
   3. Provide for the creation of an unlimited number of alarm classes for the purpose of routing types and or classes of alarms.
   4. Provide timed (schedule) routing of alarms by class, object, group, or node.
   5. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

D. Alarms shall be annunciated in any of the following manners as user defined:
   1. Screen message text
   2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
      a. Day of week
      b. Time of day
      c. Recipient
      d. Type of alarm/priority/category/level
   3. Alphanumeric Pagers.
   4. Graphic with flashing alarm object(s)
   5. Printed message, routed directly to a dedicated alarm printer

E. The following shall be recorded by the Global Controller for each alarm (at a minimum):
   1. Time and date
   2. Location
   3. Equipment (air handler #, access way, etc.)
   4. Acknowledge time, date, and user who issued acknowledgement.
   5. Number of occurrences since last acknowledgement.

F. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

G. A log of all alarms shall be maintained by the Global Controller and shall be available for review by the user.

H. Provide a "query" feature to allow review of specific alarms by user defined parameters.

I. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

J. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

K. Data Collection and Storage:
   1. The Global Controller shall have the ability to collect data for any property of any object and store this data for future use.
   2. The data collection shall be performed by log objects, resident in the Global Controller.
   3. All log data shall be stored in a relational database in the Global Controller and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.

4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
5. The Global Controller shall have the ability to archive its log data either locally (to itself), or remotely to a server or other Global Controllers on the network. Provide the ability to configure the following archiving properties, at a minimum:
   a. Archive on time of day
   b. Archive on user-defined number of data stores in the buffer (size)
   c. Archive when buffer has reached it's user-defined capacity

L. Provide and maintain an Audit Log that tracks all activities performed on the Global Controller. Provide the ability to archive the log locally (in the global Controller), to another Global Controller on the network, or to a server. For each log entry, provide the following data:
   1. Time and date
   2. User ID
   3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

M. The Global Controller shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
   1. Copies of the current database and, at the most recently saved database shall be stored in the Global Controller. The age of the most recently saved database is dependent on the user-defined database save interval.
   2. The Global Controller database shall be stored, at a minimum, in a format to allow for user viewing and editing, if desired.

N. Provisions for system expansion. The Global Controller shall not be loaded with controllers, memory usage or functionality beyond 80% of its capacity.

2.04 PROGRAMMABLE EQUIPMENT CONTROLLERS

A. Programmable Equipment Controllers (PEC'S) shall be Siemens PXC Modular Controllers with adequate spare I/O capacity and shall be stand-alone, multi-tasking, real-time digital control processors.

B. The PEC must communicate peer-to-peer with the all of the network application specific and programmable controllers sharing alarming, trending, scheduling and totalization information.

C. Programming of the PEC shall be accomplished by using graphical software that incorporates drag and drop capabilities. The PEC software database must be able to execute all of the specified mechanical system controls functions. The programming software shall be able to bundle software logic to simplify control sequencing. All values, which make up the PID output value, shall be readable and modifiable at a workstation or portable service tool. Each input, output, or calculation result shall be capable of being shared/bound with any controller or interface device on the network.

D. PEC'S shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
   1. A single process shall be able to incorporate measured or calculated data from any and all other PEC'S on the network. In addition, a single process shall be able to issue commands to points in any and all other PEC'S on the network.
   2. Processes shall be able to generate operator messages and advisories to operator I/O devices.

E. Each PEC shall support firmware upgrades. The upgrades can be accomplished remotely over the network and/or by visiting each controller.

F. Each PEC shall continuously perform self-diagnostics, which include communication diagnosis and diagnosis of all components. The PEC shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

G. In the event of the loss of normal power, there shall be an orderly shutdown of all PEC'S to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
   1. Upon restoration of normal power, the PEC shall automatically resume full operation without manual intervention.
   2. All PEC'S control programming and databases must be stored in a non volatile memory, therefore eliminating data loss, downtime and re-load time.

H. Provide PEC'S for each AHU or other HVAC system.

I. Historical data collection utilities shall be provided to manually or automatically sample and store system data for selected points. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network (The Mirage or Treasure Island), may be collected and stored.

J. Future expansion capacity. All PEC'S shall have at least two "spare" points of each type. (AI, DI, AO, DO)

2.05 APPLICATION SPECIFIC CONTROLLERS (ASC)

A. Each Application Specific Controller (ASC) shall operate as a stand-alone, peer to peer controller capable of performing its specified control responsibilities independent of other controllers in the network. Each ASC shall be a microprocessor based, multi-tasking, multi-user, real time digital control processor.

B. ASC's shall be available for:
   1. Water source heat pumps.
   2. Boiler.
   3. Circulating pumps.

C. Non-volatile memory reloads or updating of an existing control algorithm shall be completed over the network.

D. Controllers shall include all inputs and outputs necessary to perform the specified control sequences. Analog and digital outputs shall be industry standard signals such as 0-10V and 3-point floating control allowing for interface to a variety of industry standard modulating actuators. The ASC inputs and outputs shall consist of industry standards types. Inputs shall be electrically isolated from outputs, communications and power. All inputs shall be provided with an auto-calibrate function to eliminate sensing errors.

E. All controller sequences and operation shall provide closed loop control of the intended application.

F. The ASC shall be mounted remotely from the room sensor.

G. The control program shall reside in the ASC. The application program configuration information shall be stored in non-volatile memory with no battery back up.

H. After a power failure the ASC shall run the control application using the current setpoints and configuration.

I. All ASC'S shall have at least two "spare" inputs and digital outputs available for future expansion.

2.06 GRAPHICAL USER INTERFACE SOFTWARE (GUI)

A. Operator workstations must be capable of supporting any existing and new products. The operator shall not be able to distinguish the DDC points from different manufacturers when commanding, monitoring points or acknowledging alarms.

B. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The GUI software shall run on a Windows environment system. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line EMS alarms and monitoring information.

C. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
   1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
   2. A gallery of HVAC and automation symbols shall be provided including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and symbols. The user shall have the ability to add custom symbols to the gallery as required.
   3. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs & graphs.
   4. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer.
   5. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
      a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
      b. Holidays shall be set by using a graphical calendar.
   6. Commands to start and stop binary objects shall be done by mouse command from the pop-up menu. No entry of text shall be required.
   7. Adjustments to analog objects, such as set points, shall be done by mouse command using a graphical slider to adjust the value. No entry of text shall be required.

D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
   1. Create, delete or modify control strategies.
   2. Add/delete objects to the system.
   3. Tune control loops through the adjustment of control loop parameters.
   4. Enable or disable control strategies.
   5. Generate hard copy records or control strategies on a printer.
   6. Select points to be alarmed and define the alarm state.
   7. Select points to be trended over a period of time and initiate the recording of values automatically.

E. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.

F. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The Energy Manager shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

G. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

H. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

2.07 NETWORK MANAGEMENT

A. The Graphical User Interface software (GUI) shall provide complete integrated network management tools for working with integrated networks. These tools shall manage a database for all devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between devices.

B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.

D. The network management database shall be resident in the Global Controller, ensuring that anyone with proper authorization has access to the network management database at all times.

2.08 ENERGY ANALYSIS SOFTWARE PACKAGE

A. Reporting Tools:
1. It shall allow the Energy Manager to analyze data related to energy consumption
2. and building performance. It shall operate on top of a unified database of information. This information shall be gathered via the EMS network devices.
3. It shall provide the user with a library of highly flexible reporting tools which allow
4. Analysis of any data point in the database.
5. It shall rank properties and data values from either lowest to highest or highest to lowest. This feature shall have the following capabilities to rank:
   a. Type of Commodity – Electric, gas, water or sewer.
   b. Data normalization to eliminate weather and size of property as confounding variables.
   c. User definable reporting period including common periods and custom periods.
   d. Manually selecting sites to rank or automatic population with sites meeting defined parameters.
6. Relative Contribution – This report shall identify how individual points contribute to a total.
7. The user shall be able to select a group of points, calculate the aggregate consumption of the group, and report on the individual contribution of each underlying component. The format of the graphical portion shall be user definable with options for pie or bar charts.
8. Average Day – It shall display an average day for any data point or group of points, over any specified period of time. It shall have the ability to define parameters such as time periods, measurement units and points.
9. Point Trending – This feature shall allow the user to choose single or multiple points and
   a. Point trending function shall provide statistical information including correlation coefficient, mean, standard deviation and variance.
   b. Point trending function shall show a scatter plot of correlated points.
10. Equipment Operation Reports – The system shall have the ability to analyze digital points and identify run times. System shall allow for a single or multiple points to be trended simultaneously. Data shall be displayed in runtime hours and runtime percentage.

B. Other functions:
1. The user shall have the ability to view the report data in both graphical and tabular format.
2. It shall support a print function allowing the user to print the active screen.

3. When defining the parameters around a report, the user shall be able to select common time periods such as Yesterday, Last Week, Last 7 days, Last Month, Last Year and YTD. If none of the common periods are applicable, selecting "Data Range" shall allow the user to define required reporting periods.
4. The system shall have the ability to eliminate weekends, weekdays or any combination of days.
5. Within each report the system shall provide the ability to zoom in both vertically and horizontally on all graphs for higher resolution.
6. The system shall identify the intersection of any points being trending in the status line.
7. Saving Reports:
   a. It shall allow the user to easily save reports for future use.
   b. The system shall be capable of designating saved reports as public or private. Public reports will be available to all users but private reports will only be available to the individual who saved the report.
   c. Saved reports will be saved in two places. Reports will be saved as a subgroup of the report template the user is in when the report is saved and will also be saved in a favorites folder.
   d. When reports are saved using a common date range such as Last Week, the saved report will always go to the preceding week. If a custom period is selected the saved report will always save the specified data.

C. Data Organization and Normalization
1. The system shall have the ability to normalize data to eliminate confounding variables such as square footage and weather.
2. The system shall provide the user with user definable weather normalization methodology based on degree-days. The system shall allow the user to select the changeover temperature from a default value of 65 degrees F.
3. Point Groups:
   a. Users shall have the ability to create Points Groups for common groups of points.
   b. Point Groups can be unique to the user who created and named them or can be shared depending on how it is configured when created.
   c. To create a point group users manually identify each individual point to be included in a point group and name it appropriately in the configuration applet.
   d. System shall be capable of creating subgroups.
   e. System shall allow users to create either public or private subgroups with any point or group of points in the database.
   f. Subgroups shall provide a subfolder to groups created by the administrator or user.
   g. Virtual points can be logged and profiled. Virtual points shall be an aggregate of other points and/or computed values by assigning engineering formulas and multipliers.
4. Universal Comparison Feature: The software shall convert electricity, gas, and other fuels to a common measurement unit. Values can be converted to KBTU, MMBTU, CF, CCF, Fahrenheit, Celsius, etc.
5. Linking Points To Multiple Sites:
   a. The system shall be capable of linking a data point from one site to another by using the Link Point icon in site configuration. It shall be possible for weather data points to be applied across different facilities.
   b. Linked points shall provide for correlations with actual points.
   c. Linked points shall provide normalization of variables if applicable.

2.09 FIELD DEVICES

A. Provide new temperature sensors. Provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer.

B. Temperature Sensors:
   1. Temperature Sensors: Temperature sensors shall be linear precision elements with ranges appropriate for each specific application.
   2. Space (room) sensors shall be available with set point adjustment and override switch. Space sensor shall have a portable service tool jack to allow communication with the controller.
   3. Duct mounted averaging sensors shall utilize a sensing element incorporated in a copper capillary with a minimum length of 20 feet for mixed air applications and shall be Siemens model 533-380 with a 4-20ma output over the temperature range of 20/120 DGF. The sensor shall be installed according to manufacture recommendation and looped and fastened at a minimum of every 36 inches.
   4. Sunshields shall be used or provided for outside air sensors.
   5. Immersion temperature sensors shall be Siemens, 4-20ma transmitters with appropriate ranges for CHW & HW applications. Thermal-wells for immersion sensors shall be stainless steel or brass as required for the application.

C. WSHP damper actuators shall be Siemens GCA series, 0-10VDC, spring return type selected to match the damper sizes. Three point floating actuators are unacceptable.

D. Current operated switches shall be Veris H708, adjustable set point type.

E. Pressure Transmitters shall be Kele PSS2 series with 4-20ma output, gauge & enclosure.

PART 3 EXECUTION

3.01 PROJECT MANAGEMENT

A. Provide a project manager who shall, as a part of his duties, be responsible for the following activities:
   1. Coordination between the EMS Contractor and the owner.
   2. Scheduling of manpower, material delivery, equipment installation and checkout.
   3. Maintenance of construction records such as project scheduling and manpower planning and AutoCAD or Visio for project co-ordination and as-built drawings.
   4. Coordination/Single point of contact
   5. Responsible for the appearance, conduct and work of all EMS employees who work on their own or with Mirage installation personnel.

3.02 INSTALLATION METHODS

A. With the support and coordination of the EMS contractors Project Manager, the owner shall install systems and materials in accordance with manufacturer's instructions, rough-in drawings and equipment details.

B. The term "control wiring" is defined to include providing of wire, conduit, and miscellaneous materials as required for mounting and connecting electric or electronic control devices.

C. All exposed wiring, low and line voltage subject to mechanical damage, shall be run in conduit. Line and low voltage wiring shall be run in separate conduits.

D. All Global Controllers and Programmable Equipment Controllers, Relays, Transducers, etc., required for stand-alone control shall be housed in a NEMA 1 enclosure with a lockable door.

3.03 SYSTEM ACCEPTANCE

A. General: The system installation shall be complete and tested for proper operation prior to acceptance testing for the Energy Manager. A letter shall be submitted to the Energy Manager requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing

will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Energy Manager, the system will be accepted. The warranty period will start at this time.

B. Field Equipment Test Procedures: DDC control panels shall be demonstrated via a functional end-to-end test. Such that:
   1. All Global Controllers are communicating with the Graphical User Interface (GUI).
   2. All controllers communicating with the Global Controllers.
   3. All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operation verified.
   4. All analog input channels shall be verified for proper operation by comparing and recording the EMS measured value with the test instruments value.
   5. All digital input channels shall be verified by changing the state of the field device and observing and recording the appropriate change of displayed value.
   6. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.
   7. Automatic control operation shall be verified by introducing an error into the system and observing the proper corrective system response.
   8. Selected time and setpoint schedules shall be verified by changing the schedule and observing the correct response on the controlled outputs.

C. As-Built Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply "6" complete 11x17 as-built drawing sets, together with AutoCAD or Visio diskettes to the owner.

D. Operation and Maintenance Manuals: Submit three copies of operation and maintenance manuals. Include the following
   1. Manufacturer's catalog data and specifications on sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals, and any miscellaneous components used in the system. From owners existing EMS O & Ms gather data sheets for existing devices to incorporate with new EMS equipment for a complete O & M manual.
   2. An operator's manual that will include detailed instructions for all operations of the system.
   3. An operator's reference table listing the addresses of all connected input points and output points. Settings shall be shown where applicable.
   4. A programmer's manual that will include all information necessary to perform programming functions.
   5. Flow charts of the control software programs utilized in the DDC system.
   6. Flow charts of the custom software programs utilized in the DDC system as approved.
   7. Complete program listing file and parameter listing file for all programs.
   8. A copy of the warranty.
   9. Operating and maintenance cautions and instructions.

3.04 TRAINING

A. At the Owners' convenience & expense the contractor shall provide factory training by full time training instructors at the Company's Training Center for engineering personnel on hardware & software. The course objectives to include adequately preparing the owners engineering personnel to operate, maintain, program, reprogram, modify and add to the EMS. Coursework should be the same as provided to the manufacturers' branch or dealer personnel.

B. The EMS contractor shall conduct two (2) eight (8) hour training courses on site for the designated owners' personnel in the maintenance and operation of the EMS. One class shall be given upon system acceptance and the other approximately six months into the warranty.

C. The course shall include instruction on specific systems and instructions for operating the installed system to include as a minimum:
   1. HVAC system overview.
   2. Operation of Control System
   3. Function of each Component
   4. System Operating Procedures
   5. Programming Procedures
   6. Maintenance Procedures

3.05 WARRANTY

A. The EMS hardware & software furnished in this scope shall be warranted to be free from defects in both material and workmanship for a period of one (1) year of normal use and service. This warranty shall become effective the date the owner accepts the system.

PART 4 SEQUENCE OF OPERATION

4.01 GENERAL

A. All sequences shall be consistent with County of Riverside standards.

4.02 CONDENSER WATER SYSTEM

A. During unoccupied periods the cooling tower and associated pumps are off. The system is enabled by the EMS, on a predetermined schedule, by commanding on the lead condenser water pump. After a start command is sent if the pump does not prove operation, after a predetermined time delay (adjustable) the lead pump is disabled, an alarm is sent to the campus EMS PC workstations and the lag pump is started. Pump lead – lag orientation is automatically changed weekly. With proof of pump operation, via the pump current operated switch, the EMS enables the cooling tower. The cooling tower will start after water flow proof via the hard wired water flow switch proves flow through the cooling tower. Once enabled the cooling tower operates under factory furnished & wired operating & safety controls. Provisions are available for the EMS to reset the condenser water supply temperature set point based on the building load. The EMS monitors the cooling tower general alarm condition, condenser water supply and return temperatures, expansion tank pressure and pump statuses. Alarms are reported to the campus EMS PC workstations when abnormal conditions exist. (alarm set points adjustable).

4.03 HOT WATER SYSTEM

A. During unoccupied periods the boiler and associated pumps are off. The HW system is enabled by the EMS, on a predetermined schedule, by commanding on the HW circulating and main condenser water pump. After a start command is sent if the pump does not prove operation, after a predetermined time delay (adjustable) the HW circulating pump is disabled, and alarm is sent to the campus EMS PC workstations. With proof of pump operation, via the pumps current operated switch, the EMS enables the boiler. The boiler will start upon water flow proof through the boiler as sensed by the hard wired water flow switch and other safety controls. Once enabled the boiler operates under factory furnished & wired operating & safety controls. Hot water may be bypassed via control valve V1 when conditions require this operation. The EMS monitors boiler general alarm conditions, hot water supply and return temperatures, and pump statuses. Alarms are reported to the campus EMS PC workstations when abnormal conditions exist. (alarm set points adjustable).

4.04 WSHP CONTROL

A. The WSHP'S are controlled by the EMS and are enabled on a predetermined schedule. During unoccupied periods the units are disabled, the OA & EA dampers are closed and the condenser water control valve is closed. Prior to regularly scheduled building occupancy if the space temperatures sense abnormally high or low temperature conditions the WSHP is enabled and

may operate in a building warm up or cool down cycle. If, at a predetermined time (adjustable) prior to scheduled occupancy, the space temperature is below the warm up temperature set point (adjustable) the HW system is enabled and after a time delay (adjustable) the WSHP's are enabled, the OA & EA dampers remain closed, the RA damper is fully open and the unit operates until the space temperature rises to an acceptable pre occupancy set point. (adjustable) In the occupied period the unit is controlled to maintain the space air temperature set point (adjustable). Whenever the return air CO2 sensor set point (adjustable) is exceeded the temperature control of the dampers is overridden the outside & exhaust air dampers are modulated open and the condenser water flow is controlled to maintain space temperature set point. An averaging type temperature sensor, filter differential pressure transmitter continuously monitor conditions and report abnormal conditions to the campus EMS PC workstations.

4.05 EXHAUST FANS

A. Exhaust air fans are controlled by the EMS and operate on a predetermined schedule. After a fan is commanded on, after a time delay (adjustable) the fan does not prove operation via its current operated switch an alarm is sent to the EMS PC workstations.

B. For exhaust fans indicated on the Contract Drawings to function with specific air handling units to supplement the return fans, the units shall track their corresponding air handling unit supply and return fans to maintain constant space differential pressure. The exhaust fan speed shall be fine tuned via individual space pressurization sensors and their opposed blade motorize dampers and the main exhaust duct negative pressure sensors to ensure that all the individual spaces shall have proper air pressure differential.

4.06 FC1/CU1 (Data/Electrical Rooms)

A. The fan coil is controlled to maintain the space temperature set point by a stand alone programmable thermostat furnished with the fan coil unit. The outdoor condensing unit is interlocked to the FC indoor unit. The EMS shall monitor equipment function and space temperature and alarm the operator in the event of failure or fault.

END OF SECTION

SECTION 23 11 23

FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Natural gas piping buried within 5 feet of building.
2. Natural gas piping above grade.
3. Unions and flanges.
4. Valves.
5. Gas seismic valve.
6. Flexible connectors.
7. Underground pipe markers.
8. Bedding and cover materials.

B. Related Sections:

1. Division 05 - Structural Steel Framing: Product requirements for touch-up painting of structural steel.
2. Division 05 - Steel Joist Framing: Product requirements for touch-up painting of steel joists.
3. Division 08 - Access Doors and Frames: Access doors for concealed valves and accessories.
4. Division 09 - Painting and Coating: Product requirements for painting for placement by this section.
5. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment: Piping materials for gas piping systems.
6. Section 23 05 23 - General-Duty Valves for HVAC Piping: Valves for gas piping systems.
7. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
8. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for valve and pipe identification for placement by this section.
9. Section 32 11 00 - Base: Aggregate for backfill in trenches.
10. Section 31 22 00 - Grading: Product and execution requirements for excavation, backfill and trenching required by this section.

1.02 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.15 - Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.

B. American Society of Mechanical Engineers:

1. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 - 2).
2. ASME B31.9 - Building Services Piping.

C. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM D2513 – Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
4. ASTM D2683 – Standard Specification for Socket Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
5. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

D. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

E. American Water Works Association:

1. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
4. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

G. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code.

H. Underwriters Laboratories Inc.:

1. UL 842 - Valves for Flammable Fluids.

1.03 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.

C. Provide pipe hangers and supports in accordance with ASME B31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.

D. Use ball or gas cocks valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.04 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
4. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
   a. Natural gas pressure regulators.

C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

D. Test Reports: Indicate results of piping system pressure test.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements

F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.05 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of valves, piping system, and system components.

C. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists.

1.06 QUALITY ASSURANCE

A. Perform natural gas Work in accordance with NFPA 54.

B. Perform work in accordance with CPC.

C. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

D. Perform Work in accordance with applicable code AWS D1.1 for welding hanger and support attachments to building structure.

E. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.

F. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

C. Design hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of California.

1.08 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Product storage and handling requirements.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements.

B. Do not install underground piping when bedding is wet or frozen.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.12 COORDINATION

A. Division 01 - Administrative Requirements: Requirements for coordination.

B. Coordinate trenching, excavating, bedding and backfilling of buried piping systems.

1.13 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for valves excluding packing.

1.14 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two packing kits for each type and size valve.

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASTM A234/A234M forged steel welding type.
2. Joints: ASME B31.9, welded.
3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
4. High density polyethylene pipe and fittings in accordance with ASTM D-2513, Grades 2306, 3306, and 3408 with fusion joints only, similar to Driscopipe 8100-DRII Series.

2.02 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Polyethylene Pipe: ASTM D2513, SDR 11.5. Fittings: ASTM D2683 or ASTM D2513 socket type. Joints: Fusion welded; plastic to steel connections with ASTM D2513 transition fittings or risers. Pipe shall be buried 30 inches deep and backfill with sand, including identification tape and #14 insulated copper tracer wire.

B. Transition riser from below grade polyethylene pipe to above grade steel pipe; ASTM D2513, Schedule 40 steel epoxy coated casing welded or threaded end, the polyethylene end shall be fusion welded, as manufactured by "Central" or equal.

2.03 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

2.04 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.
2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
2. Copper Piping: Class 150, slip-on bronze flanges.
3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.05 GAS BALL VALVES

A. Above and Below Grade 1/4 inch to 2 inch: Two piece, threaded ends, brass body, chrome plated brass ball, reinforced teflon seats, blow-out proof stem, CSA certified, full port, similar to Jomar Model No. 175-LWN.

B. Above Grade 1-1/4 inch to 4 inch: MSS SP 110, Class 125, two piece, threaded ends, brass body, chrome plated brass ball, reinforced teflon seats, blow-out proof stem, lever handle, CSA certified, full port, similar to Apollo Model No. 94A.

2.06 GAS COCKS

A. Indoor Up to 2 Inches: Bronze body, bronze tapered plug, lubricated, Teflon packing, threaded ends, CSA certified.

B. Over 2 Inches: Cast iron body and plug, lubricated, Teflon packing, flanged ends, CSA certified.

C. Similar to McDonald Model No. 10596.

2.07 GAS SEISMIC VALVES

A. Provide a valve consisting of a swing check valve arrangement with an acceleration-sensitive triggering mechanism. The trip mechanism shall consist of a steel ball resting on a tapered cup-shaped support. The trip mechanism shall be factory set and sealed. A sight glass is provided so that the Open or Closed indicator can be seen, and the trip mechanism status of the valve can be easily determined. The valve assembly shall be certified by the California Sate Architect's Office, approved by the local authority, meet the requirements of ANSI Z21.70 and ASCE 25-97. See Schedule for Model number.

2.08 FLEXIBLE CONNECTORS

A. Coated stainless steel, fittings suitable for connection to piping system and equipment, capacity sufficient for the application, CSA Certified. Similar to Dormont Model No. 10.

PART 3 EXECUTION

3.01 EXAMINATION

A. 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION - INSERTS

A. Provide inserts for placement in concrete forms.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.04 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install hangers and supports in accordance with ASME B31.9, ASTM F708, and MSS SP 89.

B. Support horizontal piping hangers as scheduled.

C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Install hangers to allow 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

F. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

H. Prime coat exposed steel hangers and supports in accordance with Division 09. Finish paint exposed steel hangers and supports in accordance with Division 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.05 INSTALLATION - BURIED PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.

B. Verify connection to existing piping system size, location, and invert are as indicated on Drawings.

C. Establish elevations of buried piping with not less than that indicated on the drawings.

D. Establish minimum separation of 1 foot from other services piping in accordance with CPC code.

E. Remove scale and dirt on inside of piping before assembly.

F. Excavate pipe trench in accordance with Section 31 23 16 and 31 23 17.

G. Install pipe to elevation as indicated on Drawings.

H. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 6 inches compacted depth; compact to 95 percent maximum density.

I. Install pipe on prepared bedding.

J. Route pipe in straight line.

K. Install pipe to allow for expansion and contraction without stressing pipe or joints.

L. Install trace wire continuous over top of pipe, buried 6 inches below pipe line.

M. Pipe Cover and Backfilling:

1. Backfill trench in accordance with Section 31 23 23.
2. Maintain optimum moisture content of fill material to attain required compaction density.
3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in6 inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
5. Do not use wheeled or tracked vehicles for tamping.

3.06 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient.

D. Where required, bend pipe with pipe bending tools in accordance with procedures intended for that purpose.

E. Install piping to conserve building space and not interfere with use of space.

F. Size and install gas piping to provide sufficient gas to supply maximum appliance demand at pressure higher than appliance minimum inlet pressure.

G. Group piping whenever practical at common elevations.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

I. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.

J. Provide clearance for installation of insulation and access to valves and fittings.

K. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 08.

L. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer. Refer to Division 05.

M. Provide support for utility meters in accordance with requirements of utility company.

N. Breather vents may be manifolded together with piping sized for combined appliance vent requirements.

O. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Division 09.

P. Install identification on piping systems including underground piping. Refer to Section 23 05 53.

Q. Install valves with stems upright or horizontal, not inverted.

R. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

3.07 FIELD QUALITY CONTROL

A. Division 01 - Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Where gas appliance will be damaged by test pressure, disconnect appliance and cap piping during pressure test. Reconnect appliance after pressure test and leak test connection.

C. Where gas appliance is designed for operating pressures equal to or greater than piping test pressure, provide gas valve to isolate appliance or equipment from gas test pressure.

D. Pressure test natural gas piping in accordance with NFPA 54.

E. Where new branch piping is extended from existing system, pressure test new branch piping only. Leak test joint between new and existing piping with noncorrosive leak detection fluid or other approved method.

F. When pressure tests do not meet specified requirements, remove defective work, replace and retest.

G. Immediately after gas is applied to a new system, or a system has been restored after gas service interruption, check pipe for leakage.

1. Where leakage is detected, shut off gas supply until necessary repairs are complete.

H. Do not place appliances in service until leak testing and repairs are complete.

3.08 SCHEDULES

A. Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING MINIMUM HANGER ROD DIAMETER Inches	STEEL PIPE MINIMUM HANGER ROD DIAMETER Inches
1/2	4	6	3/8	3/8
3/4	6	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	8	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2	8	10	1/2	1/2
3	8	10	1/2	1/2
4	8	10	1/2	5/8
5	8	10	1/2	5/8
6	8	10	5/8	3/4
8	8	10	3/4	3/4

END OF SECTION