

SECTION 210500

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, fittings, valves, and connections for sprinkler systems.

1.2 RELATED REQUIREMENTS

- A. Section 210553 - Identification for Fire Suppression Piping and Equipment: Piping identification.
- B. Section 211300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

1.3 REFERENCE STANDARDS

- A. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2007.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers; 2005.
- C. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).
- D. ASME B16.4 - Gray Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).
- E. ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings; The American Society of Mechanical Engineers; 2007.
- F. ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded; The American Society of Mechanical Engineers; 2009.
- G. ASTM A 47/A 47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2009).
- H. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2007.
- I. ASTM A 795/A 795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2008.
- J. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2010.
- K. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; National Fire Protection Association; 2010.
- L. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.
- M. UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- N. UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.

- 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. Project Record Documents: Record actual locations of components and tag numbering.
- D. Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience, approved by manufacturer.
- C. Welders certification: In accordance with ASME (BPV IX).
- D. Conform to UL, FM, requirements.
- E. Valves: Bear UL, FM, label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- F. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 PRODUCTS

2.1 FIRE PROTECTION SYSTEMS

- A. Sprinkler Systems: Conform work to NFPA 13 International Fire Code, International Building Code and specifications.
- B. Welding Materials and Procedures: Conform to ASME Code.

2.2 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A 795 Schedule 10, or ASTM A 53 Schedule 40, black or galvanized. Allied Dyna-Thread and Dyna-Flow or similar piping may be used in lieu of Schedule 40 and Schedule 10. All threadable pipe shall have a Corrosion Resistance Ratio (CRR) of 1.00 at threads. Allied BLT, XL or similar type pipe is prohibited.
 - 1. Steel Fittings: ASME B16.9, wrought steel, buttwelded.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings.
 - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.3 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1 to 4 inch: Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 6 inches and Over: Carbon steel, adjustable, clevis.
- C. Multiple or Trapeze Hangers: Steel Unistrut channels or equal with clamps and hanger rods.
- D. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

- F. Vertical Support: Steel riser clamp.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.4 GATE VALVES

- A. Up to and including 2 inches:
 - 1. Bronze body, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.
- B. Over 2 inches:
 - 1. Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid rubber covered bronze or cast iron wedge, flanged ends.

2.5 GLOBE OR ANGLE VALVES

- A. Up to and including 2 inches:
 - 1. Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable rubber disc, threaded ends, with backseating capacity repackable under pressure.
- B. Over 2 inches:
 - 1. Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.6 BALL VALVES

- A. Up to and including 2 inches:
 - 1. Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.
- B. Over 2 inches:
 - 1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive handwheel for sizes 10 inches and over, flanged.

2.7 CHECK VALVES

- A. Up to and including 2 inches:
 - 1. Bronze body and swing disc, rubber seat, threaded ends.
- B. Over 2 inches:
 - 1. Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends with automatic ball check.
- C. 4 inches and Over:
 - 1. Iron body, bronze disc, stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

2.8 DRAIN VALVES

- A. Ball Valve:
 - 1. Brass with cap and chain, 3/4 inch hose thread.

2.9 BUTTERFLY VALVES

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

2.10 SUPERVISORY/TAMPER SWITCHES

- A. For O S & Y valve or butterfly valve installations, UL/FM listed/approved, to monitor position of valve, tamper resistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use, NEMA 4 & 6P enclosures.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.2 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- 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. Sleeve pipes passing through partitions, walls, and floors.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Installation shall be compliant with International Building Code (IBC) and NFPA requirements.
- H. Pipe Hangers and Supports:
 - 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 2. Place hangers within 12 inches of each horizontal elbow.
 - 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- I. Slope piping and arrange systems to drain at low points. Use 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.
- K. Do not penetrate building structural members unless indicated.
- L. Provide sleeves when penetrating footings, floors, ceilings and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- M. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- N. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
- O. Provide gate or ball valves for shut-off or isolating service.
- P. Provide drain valves at main shut-off valves, low points of piping and apparatus.

3.3 OWNER TRAINING

- A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 1 hour.

END OF SECTION

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SECTION 210553

IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe Markers.

1.2 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

1.3 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- D. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Major Control Components: Nameplates.
- B. Piping: Tags or Pipemarkers.
- C. Pumps: Nameplates.
- D. Relays: Tags.
- E. Small-sized Equipment: Tags.
- F. Valves: Tags or Nameplates

2.2 MANUFACTURERS

- A. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
- B. Seton Identification Products: www.seton.com.
- C. Brady Corporation: www.bradycorp.com.

2.3 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: Black.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: White.

2.4 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.5 PIPE MARKERS

- A. Color: Conform to ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Identify valves in main and branch piping with tags.
- F. Identify pumps with plastic nameplates. Small devices, such as in-line pumps may be identified with tags.
- G. Identify piping, concealed or exposed with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. 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.

END OF SECTION

SECTION 211300

FIRE SUPPRESSION SPRINKLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.

1.2 RELATED REQUIREMENTS

- A. Section 210500 - Common Work Results for Fire Suppression: Pipe, fittings, and valves.
- B. Section 210553 - Identification for Fire Suppression Piping and Equipment.
- C. Section 220553 - Identification for Plumbing Piping and Equipment.
- D. Section 262702 - Equipment Wiring Systems: Electrical characteristics and wiring connections.
- E. Section 283100 - Fire System.

1.3 REFERENCE STANDARDS

- A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2010.
- C. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meeting: Convene two weeks before starting work of this section.

1.5 SUBMITTALS

- A. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Shop Drawings:
 - 1. Submit working plans indicating sprinkler head locations coordinated with ceiling installation, pipe routing, fire department connections and riser locations.
 - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
 - 3. Submit shop drawings to authority having jurisdiction for approval. Submit proof of approval to Engineer.
- C. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- D. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- E. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
 - 2. Sprinkler Wrenches: For each sprinkler type.

1.6 QUALITY ASSURANCE

- A. Maintain one copy of referenced design and installation standard on site.
- B. Conform to UL FM requirements.
- C. Designer Qualifications: Design system under direct supervision of a NICET Level III, experienced in design of this type of work.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience approved by manufacturer.
- F. Equipment and Components: Provide products that bear UL and FM label or marking.
- G. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Sprinklers, Valves, and Equipment:
 - 1. Tyco Fire Suppression & Building Products: www.tyco-fire.com.
 - 2. Viking Corporation: www.vikinggroupinc.com.
 - 3. Reliable Automatic Sprinkler Co.: www.reliable-sprinkler.com.

2.2 SPRINKLER SYSTEM

- A. Sprinkler System: Fire protection contractor shall provide design build services based on the requirements herein specified. System shall provide coverage for building addition as noted on plans.
- B. System Piping Location: Wet system piping shall be installed at highest elevation possible. Piping shall be installed above all mechanical equipment, ductwork, and all plumbing system piping. Fire protection contractor shall coordinate fire protection piping prior to installation.
- C. Occupancy: Shall comply with NFPA 13. See plans for occupancy areas.
- D. Water Supply: Provided by city water main – Moore, Oklahoma.
 - 1. Coordinate with owner and fire department for connection of new zone to existing sprinkler riser assembly. Field verify location for connection points. Conduct hydraulic calculations for proper connection points.
 - 2. Contractor shall determine volume and pressure from water flow test data.
- E. Interface system with building control system and fire alarm system.
- F. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to fire sprinkler riser.
- G. Fire department connection - existing.

2.3 SPRINKLERS

- A. Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.
 - 1. Response Type: Quick.
 - 2. Coverage Type: Standard.
 - 3. Finish: Enamel, color white.
 - 4. Escutcheon Plate Finish: Enamel, color white.

5. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- B. Exposed Area Type: Standard upright type. Provide head guards in areas where sprinkler heads are subject to damage.
1. Response Type: Quick.
 2. Coverage Type: Standard.
 3. Finish: Brass. Chrome plated.
 4. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
1. Response Type: Quick.
 2. Coverage Type: Standard.
 3. Finish: Chrome plated.
 4. Escutcheon Plate Finish: Chrome plated.
 5. Fusible Link: Glass bulb type temperature rated for specific area hazard.

2.4 PIPING SPECIALTIES

- A. Provide proper backflow protection to fire protection system as required per Authority Having Jurisdiction.
- B. Flexible Sprinkler Drop Fittings: Corrugated Type 304 stainless steel hose with braided Type 304 stainless steel exterior cover, welded stainless steel or zinc plated steel inlet and outlet threaded fittings with EPDM seals. 175 PSI pressure rating. 225 °F temperature rating, 1" minimum internal hose diameter. 60" maximum hose length, straight or angle outlet configuration. Galvanized steel ceiling support bar and brackets selected to match project ceiling support system requirements. UL Listed and FM approved.
- C. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 120 volt AC and 2.5 amp at 24 volt DC.
- D. Fire Department Inspectors Test outlet: coordinate location and type with AHJ or Local Fire Marshall:
1. Label: "Inspectors Test".
- E. Supervisory and Tamper Switches: For O S & Y valve or butterfly valve installations, UL/FM listed/approved, to monitor position of valve, tamper resistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use, NEMA 4 & 6P enclosures.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Place pipe runs to minimize obstruction to other work.
- D. Place piping in concealed spaces above finished ceilings.
- E. Center sprinklers in one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements and provide piping offsets as required.
- F. Flexible sprinkler drop fittings: Install in accordance with manufacturer's installation instructions following minimum bend radii, maximum number of bends and bend distance from end requirements.
- G. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

- H. Flush entire piping system of foreign matter.
- I. Install guards on sprinklers where indicated.
- J. Hydrostatically test entire system.
- K. Require test be witnessed by Fire Marshal and authority having jurisdiction.
- L. Provide flow controls and alarms at sprinkler system water source connection.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system and building controls system.

3.3 OWNER TRAINING

- A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 1 hour.

END OF SECTION

SECTION 220500

COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 SCOPE

- A. This section includes information common to two or more technical plumbing specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Reference.
 - c. Standards.
 - d. Quality Assurance.
 - e. Sleeves and Openings.
 - f. Sealing and Firestopping.
 - g. Equipment Furnished By Others.
 - h. Provisions for Future.
 - i. Off Site Storage.
 - j. Codes.
 - k. Certificates and Inspections.
 - l. Submittals.
 - m. Operating and Maintenance Data.
 - n. Training of Owner Personnel.
 - o. Record Drawings.
 2. PART 2 – PRODUCTS.
 - a. Access Panels and Doors.
 - b. Sealing and Firestopping.
 3. PART 3 – EXECUTION.
 - a. Excavation and Backfill.
 - b. Sheeting, Shoring and Bracing.
 - c. Dewatering.
 - d. Rock Excavation.
 - e. Concrete Work.
 - f. Building Access.
 - g. Equipment Access.
 - h. Coordination.
 - i. Lubrication.
 - j. Sleeves.
 - k. Sealing and Firestopping.

1.2 REFERENCE

- A. This section applies to all Division 22 sections of plumbing.

1.3 STANDARDS

- A. Abbreviations of standards organizations referenced in this and other sections are as follows:
1. ACPA American Concrete Pipe Association.
 2. AGA American Gas Association.
 3. ANSI American National Standards Institute.
 4. ASME American Society of Mechanical Engineers.
 5. ASPE American society of Plumbing Engineers.
 6. ASSE American Society of Sanitary Engineering.
 7. ASTM American Society for Testing and Materials.
 8. AWWA American Water Works Association.

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| 9. | AWS | American Welding Society. |
| 10. | CISPI | Cast Iron Soil Pipe Institute. |
| 11. | CGA | Compressed Gas Association. |
| 12. | EPA | Environmental Protection Agency. |
| 13. | IAPMO | International Association of Plumbing & Mechanical Officials. |
| 14. | MCA | Mechanical Contractors Association. |
| 15. | MSS | Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc. |
| 16. | NBS | National Bureau of Standards. |
| 17. | NEC | National Electric Code. |
| 18. | NFPA | National Fire Protection Association. |
| 19. | NSF | National Sanitation Foundation. |
| 20. | PDI | Plumbing and Drainage Institute. |
| 21. | SMACNA | Sheet Metal and Air Conditioning Contractors' National Association. Inc. |
| 22. | STI | Steel Tank Institute. |
| 23. | UL | Underwriters Laboratories Inc. |

B. Standards referenced in this section:

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| 1. | ACI 614 | Recommended Practice for Measuring, Mixing and Placing of Concrete. |
| 2. | ASTM D1557 | Standard Test Method for Moisture-Density Relations of Soils. |
| 3. | ASTM E814 | Standard Test Method for Fire Tests of Through-Penetration Fire Stops. |
| 4. | ASTM E84 | Standard Test Method for Surface Burning Characteristics of Building Materials. |
| 5. | D.O.T. | Standard Specifications for Road and Bridge Construction, State of Oklahoma Dept. of Transportation. |
| 6. | UL1479 | Fire Tests of Through-Penetration Firestops. |
| 7. | UL723 | Surface Burning Characteristics of Building Materials. |

1.4 QUALITY ASSURANCE

- A. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.
- B. Substitution of Materials: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

1.5 SEALING AND FIRESTOPPING

- A. Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the responsibility of the Contractor whose work penetrates the opening. The Contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.6 EQUIPMENT FURNISHED BY OTHERS

- A. Coordinate with owner for location of kitchen equipment. Contractor shall rough-in and make final connections to equipment furnished by others. See Plumbing plans.

1.7 PROVISIONS FOR FUTURE

- A. Coordinate with owner for final location of valves for future building additions. See Plumbing plans.

1.8 OFF SITE STORAGE

- A. Prior approval by Owner and the Engineer will be needed. The Contractor shall submit Storage Agreement Form to Owner for consideration of offsite materials storage. Generally, sleeves, pipe/pipe fittings and similar rough-in material will not be accepted for offsite storage. No material will be accepted for offsite storage unless shop drawings for the material have been approved.

1.9 CODES

- A. Comply with requirements of Oklahoma Code Requirements.

1.10 CERTIFICATES AND INSPECTIONS

- A. Obtain and pay for all required State installation inspections except those provided by the Engineer in accordance with Oklahoma Code Requirements. Deliver originals of these certificates to the Owner's Project Representative. Include copies of the certificates in the Operating and Maintenance Instructions.

1.11 SUBMITTALS

- A. Refer to Division 1, for submittal procedures.
- B. Not more than two weeks after award of contract but before any shop drawings are submitted, Contractor to submit the following plumbing system data sheet. List piping material type for each piping service on the project, ASTM number, schedule or pressure class, joint type, manufacturer and model number where appropriate. List valves and specialties for each piping service, fixture and equipment with manufacturer and model number. The approved plumbing system data sheet(s) will be made available to the Owner's Project Representative for their use on this project.

PLUMBING SYSTEM DATA SHEET

<u>Item</u>	<u>Pipe Service/Sizes</u>	<u>Manufacturer/Model No.</u>	<u>Remarks</u>
Pipe.			
Hangers & Supports.			
Insulation.			
Plumbing Specialties.			
Plumbing Fixtures.			
Plumbing Equipment.			

- C. Shop drawing submittals shall be individually submitted by specification section number in PDF format. Combined submittals will be returned for contractor to divide.
- D. Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically powered equipment.
 - 1. Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:

a. Operating and Maintenance Manuals	2 copies.
b. Owner	2 copies.
c. Architect/Engineer	1 copy.
d. Owner Field Office	1 copy.

1.12 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. In addition to the general content specified under applicable sections in Bidding Requirements and Division 1 - General Requirements, supply the following additional documentation:
 - 1. Records of tests performed to certify compliance with system requirements.
 - 2. Manufacturer's wiring diagrams for electrically powered equipment.
 - 3. Certificates of inspection by regulatory agencies.
 - 4. Valve schedules.
 - 5. Lubrication instructions, including list/frequency of lubrication.
 - 6. Parts lists for fixtures, equipment, valves and specialties.
 - 7. Manufacturer's installation, operation and maintenance recommendations for fixtures, equipment, valves and specialties.
 - 8. Additional information as indicated in the technical specification sections.

1.13 TRAINING OF OWNER PERSONNEL

- A. Instruct Owner's personnel in the proper operation and maintenance of systems and equipment provided as part of this project. Include not less than six (6) hours of instruction, using the Operating and Maintenance manuals during this instruction. Demonstrate startup, operation and shutdown procedures for all equipment. All training to be during normal working hours. Videotape all instructions and provide Owner with copy.

1.14 RECORD DRAWINGS

- A. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

PART 2 PRODUCTS

2.1 ACCESS PANELS AND DOORS

- A. Concrete Walls:
 - 1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public or secured areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the item needing service; minimum size is 12" by 12".

2.2 SEALING AND FIRESTOPPING

- A. FIRE AND/OR SMOKE RATED PENETRATIONS:
 - 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Hilti: www.hilti.com.
 - c. Rectorseal: www.rectorseal.com.
 - d. STI/SpecSeal: www.stifirestop.com.
 - e. Tremco: www.tremcosealants.com.
 - 2. All firestopping systems shall be provided by the same manufacturer.
 - 3. Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the Department of Commerce.
 - 4. Submittals: Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.

5. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
 6. Use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop blocks, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.
- B. NON-RATED PENETRATIONS:
1. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water-stop type wall sleeve. The operating bolts of the mechanical type seal shall be accessible from the interior of the building.
 2. At pipe penetrations of non-rated interior partitions, floors and exterior walls, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not required use urethane caulk in annular space between pipe insulation and wall material.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

- A. Perform all excavation and backfill work necessary to accomplish indicated plumbing systems installation. Excavate to bottom of pipe and structure bedding, 4" in stable soils, 6" in rock or wet trenches and 8" in unstable soil. Finish bottoms of excavations to true, level surface.
- B. Bedding up to a point 12" inches above the top of the pipe shall be thoroughly compacted sand. Backfill above the bedding shall be thoroughly compacted excavated material free of construction debris, large stones, organic, perishable, and frozen materials. Refer to IPC section 306 – Trenching, Excavation and Backfill.
- C. Take care during bedding, compaction and backfill not to disturb or damage piping.
- D. Mechanically compact bedding and backfill to prevent settlement. The initial compacted lift to not exceed 24" compacted to 95% density per Modified Proctor Test (ASTM D-1557). Subsequent lifts under pavements, curbs, walks and structures are not to exceed 12" and be compacted to 95% density per Modified Proctor Test. In all other areas where construction above the excavation is not anticipated within 2 years, mechanically compact backfill in lifts not exceeding 24" to 90% density per Modified Proctor Test. Route the equipment over each lift of the material so that the compaction equipment contacts all areas of the surface of the lift.
- E. Strip topsoil from area to be excavated, free from subsoil and debris, and store for later respreading.
- F. At no time place excavated materials where they will impede surface drainage unless such drainage is being safely rerouted away from the excavation.
- G. Excavate whatever materials are encountered as required to place at the elevations shown, all pipe, manholes, and other work. Remove debris and rubbish from excavations before placing bedding and backfill material.
- H. Remove surplus excavated materials from site.
- I. Verify the locations of any water, drainage, gas, sewer, electric, telephone or steam lines which may be encountered in the excavation. Underpin and support all lines. Cut off service connections encountered which are to be removed at the limits of the excavation and cap.
- J. Provide and maintain all fencing, barricades, signs, warning lights, and/or other equipment necessary to keep all excavation pits and trenches and the entire subgrade area safe under all circumstances and at all times. No excavation shall be left unattended without adequate protection.

- K. Elevations shown on the plans are subject to such revisions as may be necessary to fit field conditions. No adjustment in compensation will be made for adjustments up to two (2) feet above or below the grades indicated on the plans.
- L. Install lines passing under foundations with minimum of 1-1/2 inch clearance to concrete and ensure there is no disturbance of bearing soil.

3.2 SHEETING, SHORING AND BRACING

- A. Provide shoring, sheet piling and bracing in conformance with the Oklahoma Code Requirements to prevent earth from caving or washing into the excavation. Shore and underpin to properly support adjacent or adjoining structures. Abandon in place shoring, sheet piling and underpinning below the top of the pipe, or, if approved in advance by the engineer, maintained in place until other permanent support approved by the engineer is provided.

3.3 DEWATERING

- A. Provide, operate and maintain all pumps and other equipment necessary to drain and keep all excavation pits, trenches and the entire subgrade area free from water under all circumstances. Obtain general permit from the Oklahoma Department of Natural Resources district office for discharge of construction dewatering effluent. Comply with permit requirements.

3.4 ROCK EXCAVATION

- A. Remove rock encountered in the excavation to a minimum dimension of six (6) inches outside the pipe. Rock excavation includes all hard, solid rock in ledges, bedded deposits and unstratified masses, all natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock; which material is so hard or so firmly cemented that in the opinion of the Engineer it is not practical to excavate and remove same with a power shovel except after thorough and continuous drilling and blasting. Rock excavation includes rock boulders of 1/2 cubic yard or more in volume.
- B. Rock excavation will be computed on the basis of the depth of rock removed and a trench width two (2) feet larger than the outside diameter of the pipe where one (1) pipe is laid in the trench and three (3) feet larger than the combined outside diameter where two (2) pipes are laid in the trench. Include 6" pipe and structure bedding in rock excavation. Include rock excavation shown on the plans in the Base Bid.

3.5 CONCRETE WORK

- A. Cast-in-place concrete within the building will be performed by the Division 3 Contractor unless otherwise noted. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for support or installation of plumbing piping, fixtures, specialties and equipment. Coordinate locations of equipment, pipe penetrations in wet areas, etc. with the Division 3 Contractor.

3.6 BUILDING ACCESS

- A. Arrange for the necessary openings in the building to allow for admittance or removal of all apparatus. When the building access was not previously arranged and must be provided by this Contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.7 EQUIPMENT ACCESS

- A. Install all piping, conduit and accessories to permit access to equipment for maintenance and service. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Access doors in general construction are to be furnished by the Plumbing Contractor and installed by the General Contractor.
- B. Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not require access panels.

3.8 COORDINATION

- A. Coordinate all work with other Contractors prior to installation. Any work that is not coordinated and that interferes with other Contractor's work shall be removed or relocated at the installing Contractor's expense.
- B. Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

3.9 LUBRICATION

- A. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason. Once the equipment has been run, maintain lubrication in accordance with the manufacturer's instructions until the work is accepted by the Owner. Maintain a log of all lubricants used and frequency of lubrication; include this information in the Operating and Maintenance Manuals at the completion of the project.

3.10 SLEEVES

- A. Provide galvanized sheet metal sleeves for pipe penetrations through interior and exterior walls to provide a backing for sealant or firestopping. Patch wall around sleeve to match adjacent wall construction and finish. Grout area around sleeve in masonry construction. In finished spaces where pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall. In existing poured concrete walls where penetration is core drilled, pipe sleeve is not required.
- B. Pipe sleeves are not required in interior non-rated drywall, plaster or wood partitions and sleeves are not required in existing poured concrete walls where penetrations are core drilled.
- C. Pipe sleeves in new poured concrete construction shall be schedule 40 steel pipe (sized to allow insulated pipe to run through sleeve), cast in place.
- D. In all piping floor penetrations, fire rated and non-fire rated, top of sleeve shall extend 2 inch above the adjacent finished floor. In existing floor penetrations, core drill sleeve opening large enough to insert schedule 40 sleeve and grout area around sleeve with hydraulic setting, non-shrink grout. If the pipe penetrating the sleeve is supported by a pipe clamp resting on the sleeve, weld a collar or struts to the sleeve that will transfer weight to existing floor structure.

3.11 SEALING AND FIRESTOPPING

- A. FIRE AND/OR SMOKE RATED PENETRATIONS:
 - 1. Install approved product in accordance with the manufacturer's instructions where a pipe penetrates a fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier.
 - 2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support substantial weight.
- B. NON-RATED PARTITIONS:
 - 1. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, in accordance with manufacturer's instructions.
 - 2. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.

END OF SECTION

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SECTION 220516

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.

1.2 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping.

1.3 REFERENCE STANDARDS

- A. ASTM A 269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2008.
- B. EJMA (STDS) - EJMA Standards; Expansion Joint Manufacturers Association; 2003.

1.4 SUBMITTALS

- A. 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.
- B. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.

PART 2 PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com.
 - 2. Metraflex Company: www.metraflex.com.
- B. Inner Hose: Stainless Steel.
- C. Exterior Sleeve: Single braided, Stainless Steel.
- D. Pressure Rating: 125 psi and 450 degrees F.
- E. Joint: As specified for pipe joints.
- F. Size: Use pipe sized units.

2.2 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturer:
 - 1. Mercer Rubber Company: www.mercer-rubber.com.
 - 2. Metraflex Company: www.metraflex.com.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi and 450 degrees F.
- E. Joint: As specified for pipe joints.
- F. Size: Use pipe sized units.

G. Application: Copper piping.

2.3 EXPANSION JOINTS

A. Manufacturers:

1. Mercer Rubber Company: www.mercer-rubber.com.
2. Metraflex Company: www.metraflex.com.

B. Shall consist of two flexible sections of hose and braid, two 90 degree elbows and a 180 degree return assembled in such a way that piping does not change direction but maintains its course along a single axis. Approved for use with potable water.

C. Size: Use pipe sized units.

D. Application: Copper piping.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

D. 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.

E. Install flexible pipe expansion loops on pipes before penetration of safe-room walls.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION

SECTION 220519

METERS AND GAGES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pressure gages and pressure gage taps.
- B. Thermometers and thermometer wells.

1.2 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers; 2005.
- B. ASTM E 1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2007.
- C. ASTM E 77 - Standard Test Method for Inspection and Verification of Thermometers; 2007.

1.3 SUBMITTALS

- A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

1.4 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 PRESSURE GAGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 - 2. Moeller Instrument Co., Inc: www.moellerinstrument.com.
 - 3. Omega Engineering, Inc: www.omega.com.
- B. Pressure Gages: ASME B40.100, UL 404 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube or Cast aluminum with phosphor bronze bourdon tube.
 - 2. Size: 4-1/2 inch or 3-1/2 inch diameter.
 - 3. Mid-Scale Accuracy: Two percent.
 - 4. Scale: Psi.

2.2 PRESSURE GAGE TAPPINGS

- A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.
- B. Needle Valve: Brass or Stainless Steel, 1/4 inch NPT for minimum 150 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

2.3 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 - 2. Weksler Glass Thermometer Corp: www.wekslerglass.com.
 - 3. H. O. Terrice: www.terrice.com.

- B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E 1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear glass.
 - 3. Stem: 3/4 inch NPT brass.
 - 4. Accuracy: 2 percent, per ASTM E 77.
 - 5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in locations where indicated on the drawings and/or details, with scale range appropriate to the system operating pressures.
- C. Gauge Valves: Install at each gauge location as close to the main as possible and at each location where a gauge tapping is indicated.
- D. Install pressure gages with pulsation dampers. Provide gage cock or needle valve to isolate each gage. Provide siphon on gages in steam systems. Extend nipples and siphons to allow clearance from insulation.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- G. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.2 SCHEDULES

- A. Stem Type Thermometers, Location and Scale Range:
 - 1. Domestic Hot water supply and recirculation, 30 to 240 Deg. F.
- B. Pressure Gages, Location and Scale Range:
 - 1. Circulation pumps, 0 to 160 psi.

END OF SECTION

SECTION 220548

VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolators.

1.2 SUBMITTALS

- A. Product Data:
 - 1. Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

1.3 QUALITY ASSURANCE

- A. Perform design and installation in accordance with applicable codes.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Isolation Technology, Inc: www.isolationtech.com.
- B. Kinetics Noise Control, Inc: www.kineticsnoise.com.
- C. Mason Industries: www.mason-ind.com.
- D. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

2.2 VIBRATION ISOLATORS

- A. Restrained Open Spring Isolators:
 - 1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
 - 2. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 - 3. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
 - 4. Restraint: Provide heavy mounting frame and limit stops.
 - 5. For Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- B. Neoprene Pad Isolators:
 - 1. Rubber or neoprene waffle pads.
 - 2. Hardness: 30 durometer.
 - 3. Thickness: Minimum 1/2 inch.
 - 4. Maximum Loading: 50 psi.
 - 5. Rib Height: Maximum 0.7 times width.
 - 6. Configuration: Single layer.

PART 3 EXECUTION

3.1 INSTALLATION

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

END OF SECTION

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SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe Markers.

1.2 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

1.3 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- D. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Major Components: Nameplates.
- B. Piping: Tags or Pipe markers.
- C. Small-sized Equipment: Tags.
- D. Tanks: Nameplates.
- E. Valves: Tags.

2.2 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Kolbi Pipe Marker Company: www.kolbipipemarkers.com.
- C. Seton Identification Products: www.seton.com.
- D. Craftmark: www.craftmarkid.com.

2.3 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: Black.

2.4 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum-1/2 inch diameter.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.5 PIPE MARKERS

A. Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

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

PART 3 EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

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

F. Identify piping, concealed or exposed with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller.

1. Identify service, flow direction, and pressure.

2. Install in clear view and align with axis of piping.

3. 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.

END OF SECTION

SECTION 220719

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

- A. ASTM C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus; 2004.
- B. ASTM C 547 - Standard Specification for Mineral Fiber Pipe Insulation; 2007.
- C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.
- D. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.
- E. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience. Products shall be manufactured at facilities certified and registered to conform to ISO 9001 Quality Standard.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum with minimum three years of documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Protect materials against damage before, during and after installation. No material shall be installed that has become damaged in any way.

1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.
- B. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.

2.2 GLASS FIBER

- A. Manufacturers:
 - 1. Knauf Insulation: www.knaufusa.com.
 - 2. Johns Manville Corporation: www.jm.com.
 - 3. Owens Corning Corporation: www.owenscorning.com.
 - 4. CertainTeed Corporation: www.certainteed.com.
- B. Insulation: ASTM C 547 and ASTM C 795; rigid molded, noncombustible.
 - 1. 'K' value: ASTM C 177, 0.24 at 75 degrees F.
 - 2. Maximum service temperature: 850 degrees F.
 - 3. Maximum moisture absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film with self-sealing longitudinal closure laps and butt strips; moisture vapor transmission when tested in accordance with ASTM E 96/E 96M of 0.02 perm-inches.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Vapor Barrier Lap Adhesive:
 - 1. Compatible with insulation.
- F. Insulating Cement/Mastic:
 - 1. ASTM C 195; hydraulic setting on mineral wool.
- G. Fibrous Glass Fabric:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
 - 2. Blanket: 1.0 lb/cu ft density.
 - 3. Weave: 5x5 10x10.
- H. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
 - 1. Armacell International: www.armacell.com.
 - 2. Aeroflex: www.aeroflexusa.com.
 - 3. Nomaco Insulation: www.nomacoinsulation.com.
- B. Insulation: Preformed closed cell flexible elastomeric cellular rubber insulation complying with ASTM C 534 Grade 1; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: -40 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.4 JACKETS

- A. PVC Plastic.
 - 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com.

- b. Knauf Insulation: www.knaufusa.com.
- 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
- 3. Covering Adhesive Mastic:
 - a. Compatible with insulation.

2.5 INSULATION INSERTS AND PIPE SHIELDS:

- A. Manufacturers:
 - 1. B-Line: www.bline.com.
 - 2. Pipe Shields: www.pipeshieldinc.com.
 - 3. Value Engineered Products: www.valueng.com.
- B. Construct inserts with calcium silicate, minimum 140 psi compressive strength. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom of supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.
- C. Where Contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered pre-manufactured product described above. On low temperature systems, extruded polystyrene may be substituted for calcium silicate provided insert and shield length and gauge are increased to compensate for lower insulation compressive strength.
- D. Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1" x 6" block for piping through 2-1/2" and three 1" x 6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency to pre-engineered/pre-manufactured product described above.
- E. Wood blocks will not be accepted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with PVC fitting covers.
- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.

2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with PVC fitting covers.
- H. Inserts and Shields:
1. Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert location: Between support shield and piping and under the finish jacket.
- I. Continue insulation through walls, ceilings, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. Vapor barriers shall be maintained continuous through all penetrations.
- J. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- K. Use full-length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.

3.3 SCHEDULES

- A. Plumbing Systems:
1. Domestic Water Supply Above Grade: Hot Water, Cold Water and Circulating Water.
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: Mains and branch lines 1 inch.
 - 3) Thickness: Branch lines serving individual fixtures, 1 inch.
 2. Domestic Water Supply Below grade: Cold Water.
 - a. Preformed Flexible Elastomeric Cellular Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.
 - b. Insulation rated for direct burial.
 3. Roof Drains Bodies:
 - a. Glass Fiber Insulation, 1" thick.
 4. Roof Drainage Above Grade:
 - a. Glass Fiber Insulation.
 - b. Thickness: Mains and branch lines 1 inch.

END OF SECTION

SECTION 221005

PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for piping systems.
 - 1. Sanitary sewer.
 - 2. Domestic water.
 - 3. Storm sewer.
 - 4. Natural gas.

1.2 RELATED REQUIREMENTS

- A. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.
- B. Section 220553 - Identification for Plumbing Piping and Equipment.
- C. Section 220719 - Plumbing Piping Insulation.

1.3 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 1999, and addenda A&B (R2004).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers; 2005.
- C. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).
- D. ASME B31.1 - Power Piping; The American Society of Mechanical Engineers; 2007 (ANSI/ASME B31.1).
- E. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).
- F. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2007.
- G. ASTM A 74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2006.
- H. ASTM B 42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2002.
- I. ASTM B 88 - Standard Specification for Seamless Copper Water Tube; 2003.
- J. ASTM D 1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2006.
- K. ASTM D 2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter; 2003.
- L. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2005.
- M. ASTM D 2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter; 2003.
- N. ASTM D 2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2006.
- O. ASTM D 2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2008.

- P. ASTM D 3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2006.
- Q. ASTM F 441/F 441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2002.
- R. ASTM F 876, ASTM F 877 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing 1. Engel or PEX-a method.
- S. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 2005 (ANSI/AWWA C651).
- T. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution; American Water Works Association; 2007 (ANSI/AWWA C900).
- U. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service; American Water Works Association; 2008.
- V. AWWA C950 - Fiberglass Pressure Pipe; American Water Works Association; 2007 (ANSI/AWWA C950).
- W. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2005.
- X. 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; Cast Iron Soil Pipe Institute; 2004.
- Y. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.
- Z. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.
- AA. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.
- BB. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 1996.
- CC. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2009.

1.4 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- B. Project Record Documents: Record actual locations of valves.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Oklahoma standards.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welder Qualifications: Certified in accordance with ASME B31.9 Building Services Piping.
- D. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.6 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with State of Oklahoma, City of Moore plumbing code.
- B. Conform to applicable code for installation of backflow prevention devices.

- C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BELOW GRADE

- A. PVC Pipe: Schedule 40 ASTM D 2665.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D 2564 solvent cement.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

- A. PVC Pipe: Schedule 40 ASTM D 2665.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D 2564 solvent cement.

2.3 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cross-Linked Polyethylene Tubing (PEX-a or Engel method): ASTM F 876, ASTM F 877
 - 1. Fittings: ASTM F 1960.
 - 2. Joints: No joints located below grade.
 - 3. Install per manufacturer's instructions.
 - 4. Provide PVC sleeve at penetrations of concrete floor.
- B. Copper Pipe: ASTM B 88, Type K (Annealed Temper).
 - 1. Fittings: cast copper pressure fittings, ANSI B16.18; wrought copper pressure fittings, ANSI B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; or cast copper flared pressure fittings, ANSI B16.26.
 - 2. Joints: No joints below grade.
 - 3. Application: piping for trap primers only.
- C. Tracer wire for non-metallic and plastic pipe: Magnetic detectable conductor, plastic covering, rated for underground service, imprinted with words "Water Service".

2.4 WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B 32, alloy Sn95 solder.
 - 3. Mechanical press sealed fittings, 3" size and smaller. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Fittings shall be double pressed type NSF/ANSI 61 approved and utilize EPDM sealing elements. Sealing elements shall be factory installed.
- B. Cross-Linked Polyethylene Tubing (PEX-a or Engel method): ASTM F 876, ASTM F 877
 - 1. Fittings: ASTM F 1960.
 - 2. Locations: concealed branch lines to individual fixture, no exposed tubing.
 - 3. Install per manufacturer's instructions.
 - 4. Approved for contact with potable water in accordance with NSF 61 and NSF 14.

2.5 STORM WATER PIPING BELOW GRADE

- A. PVC Pipe: Schedule 40 ASTM D 2665.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D 2564 solvent cement.

2.6 STORM WATER PIPING ABOVE GRADE

- A. PVC Pipe: Schedule 40 ASTM D 2665.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D 2564 solvent cement.

2.7 NATURAL GAS PIPING – ABOVE GRADE

- A. Steel Pipe: ASTM A 53/A 53M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A 234/A 234M, wrought steel welding type.
 - 2. Joints: NFPA 54, threaded or welded to ASME B31.1,
 - 3. Mechanical press sealed fittings, 65 mm (2-1/2”) in size and smaller. Fittings shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria ANSI LC-4/CSA 6.32 and NFPA-54. Sealing elements for press fittings shall be HNBR. Wrought carbon steel and alloy steel. Sealing elements shall be factory installed.
- B. Corrugated Stainless Steel Tubing (CSST): ANSI LC-1 Standard, ASTM A240, Type 304, 321 stainless steel with 2400 degrees F melting point.
 - 1. Jacket: UV resistant polyethylene with 350 degrees F melting point and fire-resistance tested in accordance with ASTM E84.
 - 2. Fittings: Mechanical type complying with ASTM B 16.
 - 3. Use CSST tubing for equipment connections only. Do not use for mains or exterior use.

2.8 NATURAL GAS PIPING, BURIED OUTSIDE OF BUILDING

- A. Polyethylene Pipe – Medium Density (MDPE): ASTM D 2513
 - 1. Fittings: ASTM D 2683 or ASTM D 2513 socket type.
 - 2. Joints: Fusion welded.
- B. Exterior below grade use only.
- C. Provide anodeless gas riser for transition from below grade to above grade.

2.9 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 Inches and Under:
 - 1. Ferrous pipe: Class 150 malleable iron threaded unions.
 - 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Size Over 1 Inch:
 - 1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 - 2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.10 PIPE HANGERS AND SUPPORTS

- A. Plumbing Piping - Drain, Waste, and Vent:
 - 1. Conform to ASME B31.9 ASTM F 708 MSS SP-58, MSS SP-69, MSS SP-89.
 - 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/ Inches: Malleable iron, adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel Unistrut channels or equal with clamps and hanger rods.
 - 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 6. Wall Support for Pipe Sizes 4 Inches and Over: 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.
- B. Plumbing Piping - Water:
1. Conform to ASME B31.9, ASTM F 708 MSS SP-58, MSS SP-69, MSS SP-89.
 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
 5. Multiple or Trapeze Hangers: Steel Unistrut channels or equal with clamps and hanger rods.
 6. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 7. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 8. Vertical Support: Steel riser clamp.
 9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 10. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.11 BALL VALVES

- A. Manufacturers:
1. Conbraco Industries: www.conbraco.com.
 2. Nibco, Inc.: www.nibco.com.
 3. Milwaukee Valve Company: www.milwaukeevalve.com.
- B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder or threaded ends with union. Provide valve stem extensions for valves installed in all piping with insulation.
1. Domestic water: Valves shall be lead-free design (NSF/ANSI 372) and comply with NSF/ANSI 61 for potable water use.
- C. Natural Gas Ball valves – 4" and smaller: Ball or eccentric plug valve, bronze or cast iron body, 2" and under threaded ends, 2-1/2" and over flanged ends, chrome plated bronze ball, bronze or nickel plated cast iron plug, TFE or Hycar seats and seals, lever handle, 175 psi W.O.G., U.L listed for use as natural gas shut-off.

2.12 SPRING LOADED CHECK VALVES

- A. Manufacturers:
1. Watts: www.watts.com.
 2. Apollo Valves.
 3. Nibco.
- B. 2" and smaller: Bronze body, sweat or threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, Class 125, teflon seat unless only bronze available, sweat or threaded ends.
- C. Valves shall be lead-free design and rated for domestic potable water use.

2.13 RELIEF VALVES

- A. Temperature and Pressure Relief:
1. Manufacturers:
 - a. Taco: www.taco-hvac.com.
 - b. Watts Regulator Company: www.wattsregulator.com.
 2. AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME (BPV IV) certified and labeled.

2.14 STRAINERS

- A. Manufacturers:
 - 1. Armstrong International, Inc.: www.armstronginternational.com.
 - 2. Watts: www.watts.com.
 - 3. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Size 2 inch and Under:
 - 1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- C. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install water service entrance piping in accordance with requirements of school district and city of Moore.
- C. Provide tracer wire for below grade non-metallic piping.
- D. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- E. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- F. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- G. Group piping whenever practical at common elevations.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 220516.
- I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 220719.
- J. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with General Contractor.
- K. Establish elevations of buried piping outside the building to ensure proper cover.
- L. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- 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. Provide support for utility meters in accordance with requirements of utility companies.
- O. Excavate in accordance with Division 31.
- P. Backfill in accordance with Division 31.

- Q. Install valves with stems upright or horizontal, not inverted.
- R. Install water piping to ASME B31.9.
- S. PVC Pipe: Make solvent-welded joints in accordance with ASTM D 2855.
- T. Sleeve pipes passing through partitions, walls and floors.
- U. Pipe Hangers and Supports:
 - 1. Installation shall be compliant with International Building Code (IBC) for Class D seismic site requirements.
 - 2. Install in accordance with MSS SP-58, MSS SP-69, MSS SP-89, ASME B31.9.
 - 3. Support horizontal piping as scheduled.
 - 4. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 5. Place hangers within 12 inches of each horizontal and vertical elbow.
 - 6. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 7. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 8. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 9. Provide copper plated hangers and supports for copper piping sheet lead packing between hanger or support and piping.
 - 10. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - 11. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 220548.
 - 12. Support cast iron drainage piping at every joint.
- V. Install PEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook.
- W. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
- X. Install pipe identification per section 220553, this section and all applicable codes.
- Y. Press connections: Copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The joints shall be pressed using the tool(s) approved by the fitting manufacturer.
- Z. Natural gas: Pitch horizontal piping down 1" in 60 feet in the direction of flow. Install a 4" minimum depth dirt leg at the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main. Teflon tape is acceptable for use on natural gas lines. Do not install gas pipe in a ventilation air plenum.
 - 1. Clean all gas piping before all regulators and service valves are installed and before unit connections are made. Test by placing target cloth over piping and blow with compressed air. Clean piping until target cloth is clean and free of debris.
 - 2. Install a shut off valve at each appliance. Provide a valve connection at the main for equipment and appliances furnished by others.
 - 3. Each gas pressure reducing valve vent and relief valve shall have a vent limiter or vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
 - 4. Paint all exposed natural gas pipe with zinc rich primer and two coats of enamel formulated paint for metal surfaces. Color to be yellow or as selected by Architect.

3.4 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install ball valves for throttling, bypass, or manual flow control services.
- E. Provide ball valves in natural gas systems for shut-off service.
- F. Provide spring loaded check valves on discharge of water pumps.
- G. Provide flow controls in water recirculating systems where indicated.

3.5 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot for piping less than 3 inches and 1/8 inch per foot slope for piping 3 inches or greater for interior piping. Install exterior piping pitched to drain at indicated elevations and slope.
- B. Water Piping: Slope piping to drain at low points.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect water distribution system as required per state and local codes.
- B. Prior to starting work, verify system is complete, flushed and clean.
- C. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651, AWWA C652 or local authority having jurisdiction.

3.7 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal above grade piping until it has been successfully tested.
- B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.
- C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
- D. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.
- E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.
- F. Entire test must be witnessed by the Authority Having Jurisdiction.
- G. Leak test: Shall conform to requirements of IPC and local codes.
 - 1. Water supply system.
 - 2. Drainage and vent system.
- H. Gas piping systems:
 - 1. Perform initial pressure test prior to concealing tubing with wall and ceiling finishes and before connecting appliances.

2. Perform final pressure test after construction is complete and finishes applied, system may be re-tested to verify no damage has occurred to gas piping system.
3. Connect appliances and equipment to gas piping system and test connections for leakage.

3.8 SERVICE CONNECTIONS

- A. Provide new sanitary and storm sewer services with connection to new sewer lines. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing. Coordinate sewer location and invert elevation with site contractor.
- B. Domestic water: Before commencing work check locations and sizes of existing cold water main. Provide new water service to addition with shut-off valve and connect to existing system. Coordinate with owner for any existing water system shut down for making new connection.
 1. Coordinate water service requirements with Moore school district.
- C. Provide new natural gas service from existing exterior gas meter. Gas service distribution piping after meter to have initial minimum pressure of 2 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment. New gas service and meter, coordinate new gas load with Gas company (ONG).

3.9 SCHEDULES

- A. Pipe Hanger Spacing:
 1. Metal Piping:
 - a. Pipe size: 1/2 inches to 1-1/4 inches:
 - 1) Maximum hanger spacing: 6 ft.
 - 2) Hanger rod diameter: 3/8 inches.
 - b. Pipe size: 1-1/2 inches to 2 inches:
 - 1) Maximum hanger spacing: 10 ft.
 - 2) Hanger rod diameter: 3/8 inch.
 - c. Pipe size: 2-1/2 inches to 3 inches:
 - 1) Maximum hanger spacing: 10 ft.
 - 2) Hanger rod diameter: 1/2 inch.
 2. Plastic Piping - PVC:
 - a. All Sizes:
 - 1) Maximum hanger spacing: 4 ft.
 - 2) Hanger rod diameter: 3/8 inch.
 3. Cross-linked Polyethylene (PEX-a) piping:
 - a. All Sizes:
 - 1) Maximum hanger spacing: 2'-8".
 - 2) Hanger rod diameter: 3/8 inch.
 - 3) Hanger spacing per piping manufacturer's instructions.
 - b. The use of horizontal rigid metal channel supporting the tubing with hangers spaced at maximum of 6 ft. per tubing manufacturer's instructions shall be allowed with approval of local plumbing code.

END OF SECTION

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SECTION 221006

PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roof drains.
- B. Floor drains and floor sinks.
- C. Cleanouts.
- D. Hydrants.
- E. Water hammer arrestors.
- F. Thermostatic mixing valves.
- G. Trap primer valves.
- H. Sanitary backwater valves.
- I. Refrigerator valve and recessed box.
- J. Thermostatic balancing valve.

1.2 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping.
- B. Section 223000 - Plumbing Equipment.
- C. Section 224000 - Plumbing Fixtures.

1.3 REFERENCE STANDARDS

- A. ASME A112.6.4 - Roof, Deck, and Balcony Drains; The American Society of Mechanical Engineers; 2003.
- B. ASSE 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering; 2004 (ANSI/ASSE 1011).
- C. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; American Society of Sanitary Engineering; 2002 (ANSI/ASSE 1012).
- D. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type; American Society of Sanitary Engineering; 2004, and Errata 2005 (ANSI/ASSE 1019).
- E. PDI-WH 201 - Water Hammer Arresters; Plumbing and Drainage Institute; 2006.

1.4 SUBMITTALS

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- C. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements, for additional provisions.
 - 2. Extra Loose Keys for Outside wall hydrants: Two.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 DRAINS

- A. Manufacturers:
 - 1. Sioux Chief Manufacturing: www.siouxchief.com.
 - 2. Wade Drains: www.wadedrains.com.
 - 3. Zurn Industries, Inc.: www.zurn.com.
 - 4. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Roof Drain:
 - 1. Assembly: ASME A112.6.4. Galvanized cast iron with sump. Cast iron dome strainer integral gravel stop, membrane flange and adjustable deck clamp as required for installation.
- C. Downspout Nozzles: Bronze round with wall flange and offset bottom section.
- D. Floor Drain:
 - 1. ASME A112.6.3; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round adjustable nickel-bronze strainer. Trap primer connection. Vandal resistant strainer screws.
 - 2. Adjustable strainer height after concrete floor is poured for strainer flush with finished floor covering.
- E. Floor Sink:
 - 1. ASME, square cast iron body with anchor flange, white acid resisting porcelain enamel interior and top, ABS anti-splash interior bottom dome strainer, medium duty square 1/2 grate.
- F. Refer to Plumbing Fixture Schedule on plans.

2.2 CLEANOUTS

- A. Manufacturers:
 - 1. Wade Drains: www.wadedrains.com.
 - 2. Zurn Industries, Inc.: www.zurn.com.
 - 3. Sioux Chief Manufacturing: www.siouxchief.com.
 - 4. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Cleanouts at Exterior Areas :
 - 1. Line type with lacquered cast iron body and round epoxy coated gasketed cover. Cast iron cleanout ferrule with threaded brass raised head. Access housing with adjustable anchor flange and extra heavy secured scoriated ductile iron cover with vandal resistant screws. Provide concrete pad for cleanout.
- C. Cleanouts at Interior Finished Floor Areas:
 - 1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas. Provide cover with vandal-proof screws.

- D. Cleanouts at Interior Finished Wall Areas:
 - 1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with vandal-proof screw.
- E. Refer to Plumbing Fixture Schedule on plans.

2.3 HYDRANTS

- A. Manufacturers:
 - 1. Woodford Manufacturing: www.woodfordmfg.com.
 - 2. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 - 3. Zurn Industries, Inc.: www.zurn.com.
 - 4. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Roof Hydrant:
 - 1. ASSE 1052; Freezeproof / Pollution-proof post-type, with below-roof reservoir with locking handle, 1" or 3/4" inlet, 3/4" hose thread outlet, ASSE 1052 backflow preventer outlet, 1-1/4" galvanized steel casing pipe, freeze resistant, roof mounting hardware, below roof deck drain outlet to be piped to nearest hub drain or floor sink.
- C. Wall Hydrants:
 - 1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall box with hinged door hose thread spout, removable key and integral vacuum breaker.
- D. Refer to Plumbing Fixture Schedule on plans.

2.4 WATER HAMMER ARRESTORS

- A. Manufacturers:
 - 1. Wade Drains: www.wadedrains.com.
 - 2. Watts Water Technologies: www.watts.com.
 - 3. Zurn Industries, Inc.: www.zurn.com.
 - 4. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Water Hammer Arrestors:
 - 1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psi working pressure.

2.5 THERMOSTATIC MIXING VALVES

- A. Thermostatic Mixing Valves:
 - 1. Manufacturers:
 - a. Watts Water Technologies: www.watts.com.
 - b. Lawler Manufacturing: www.temperedwater.com.
 - c. Leonard Valve Company: www.leonardvalve.com.
 - d. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Valve: Lead free brass body, integral temperature, adjustment, check valves. Valve shall be ASSE 1070 listed.

2.6 TRAP PRIMER VALVES

- A. Manufacturers:
 - 1. Sioux Chief Manufacturing: www.siouxchief.com.
 - 2. Precision Plumbing Products (PPP) Industries: www.pppinc.com.
 - 3. Zurn: www.zurn.com.
 - 4. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

- B. Bronze body, O-ring seals, integral threaded outlet vacuum breaker, adjustable, in conformance with ANSI/ASSE 1018.
 - 1. Provide distribution unit for up to four outlets.
- C. Electric trap priming assembly: the primer will come with an electronic timer that will deliver 2 ozs of water to floor drains every 24 hours. The primer will come complete with a solenoid valve, electronic timer, ½" male inlet, an air gap fitting with a ½" female thread outlet and hard-wired electrical connection (120 volt). The primer will come with a test switch to test functionality. Provide distribution unit for up to four outlets or manifold for over 4 outlets.
- D. Refer to Plumbing Fixtures Schedule on plans. Provide as required by local codes.

2.7 SANITARY BACKWATER VALVES

- A. Manufacturers:
 - 1. Rectorseal: www.rectorseal.com.
 - 2. Oatey: www.oatey.com.
 - 3. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. PVC body with valve flapper, valve extension pipe with tee handle for manual operation of flapper valve, threaded collar for access riser to grade, threaded access cover.
- C. Refer to Plumbing Fixtures Schedule on plans.

2.8 REFRIGERATOR VALVE AND RECESSED BOX

- A. Box Manufacturers:
 - 1. IPS Corporation/Water-Tite: www.ipscorp.com.
 - 2. Oatey: www.oatey.com.
 - 3. Sioux chief:
 - 4. Substitutions: Refer to Bidding Requirements and Division 1 - General Requirements.
- B. Description: Plastic preformed rough-in box with quarter turn brass valve, water hammer arrestor, slip in finishing cover.
- C. Refer to Plumbing Fixture Schedule on plans.

2.9 THERMOSTATIC BALANCING VALVE

- A. Manufacturers:
 - 1. ThermOmegaTech: www.circuitsolver.com.
 - 2. Caleffi North America, Inc: www.caleffi.com.
 - 3. Substitutions: Refer to Bidding Requirements and Division 1 - General Requirements.
- B. Valve: thermostatically controlled balancing valve shall be self contained and fully automatic. Valve shall regulate flow of recirculated domestic hot water based on water temperature entering valve regardless of system operating pressure. When fully closed the valve shall bypass a minimum amount of hot water to maintain dynamic control of the recirculating loop. Valve shall be NSF-61 certified for use in all domestic water systems.
- C. Refer to Plumbing Fixture Schedule on plans.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Set floor drains, roof drains, trench drains and cleanouts level and plumb adjusted to finished floor elevation, roof elevation or finished wall location. Locate where serviceable. Allow minimum of 18" clearance around cleanouts for rodding. Lubricate threaded cleanout plugs with graphite and oil, teflon tape or waterproof grease. Install trap primer connections where indicated. Provide deep seal traps on floor drains and hub drains installed in mechanical rooms,

penthouses or rooms with excessive positive or negative pressure.

- C. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rotting of drainage system.
- D. Encase exterior cleanout and backwater valve covers in concrete flush with grade.
- E. Install sanitary backwater valve per manufacturer's instructions.
- F. Install floor cleanouts at elevation to accommodate finished floor.
- G. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur.
- H. Pipe relief from backflow preventer to nearest drain.
- I. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping as shown on plans. Provide access panels as required.
- J. Install backflow preventers in accordance with Oklahoma requirements maintaining minimum clearance distances for servicing and testing. Provide indirect waste piping with air gap installation from relief opening to above hub drain or floor drain.
- K. Install trap primer assemblies in accessible location and per manufacturer's instructions. Slope piping from trap primer towards floor drain. Coordinate power outlet with electrical contractor for electric trap primer assembly.
- L. Coordinate roof hydrant installation with roofing contractor. Slope drain line from hydrant to nearest hub drain or floor sink. Install hydrant per manufacturer's recommendations.
- M. Mount wall hydrants recessed in exterior wall construction with valve plug extended beyond interior side of building insulation. Slope to drain to exterior. Install so discharge is 18" min. above finished grade. Set wall box in grout or caulk and fill exterior wall penetration with insulation.
- N. Equipment by others: Provide rough-in piping and make final and necessary connections as required by equipment supplier.
- O. Thermostatic balancing valve: Installation of valve shall be made by qualified tradesmen. Install valve in each domestic hot water return piping branch beyond last hot water device in that branch. Provide suitable line size isolation valves, unions, and strainer as recommended by manufacturer. Provide suitable access panel as required in non-accessible ceilings and walls.

3.2 OWNER TRAINING

- A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 1 hour.

END OF SECTION

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SECTION 223000

PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water Heaters.
- B. Electronic Descaler.
- C. Thermal expansion tanks.
- D. Circulation pumps.

1.2 RELATED REQUIREMENTS

- A. Section 262702 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2007.
- B. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- C. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Provide electrical characteristics and connection requirements.
- B. Shop Drawings:
 - 1. Indicate heat exchanger dimensions, size of tappings, and performance data.
 - 2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- C. Project Record Documents: Record actual locations of components.
- D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

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

1.6 CERTIFICATIONS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- B. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1 or ANSI Z21.10.3, as applicable, in addition to requirements specified elsewhere.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.8 WARRANTY

- A. Refer to Bidding Requirements and Division 1 - General Requirements, for additional warranty requirements.

PART 2 PRODUCTS

2.1 COMMERCIAL GAS-FIRED WATER HEATERS – TANKLESS TYPE

- A. Manufacturers:
 - 1. Navien Inc.: www.navien.com.
 - 2. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Type: Tankless, automatic, natural gas-fired, modulating burner with 10-1 turn down ratio, high efficiency, sealed combustion, condensing, direct vent exhaust and air intake, wall mounted. Unit shall have built-in control panel with diagnostics display. Multiple units shall be connected with communications cable from manufacturer.
- C. Performance: Refer to Water Heater Schedule on plans.
- D. Accessories: Provide:
 - 1. Temperature and Pressure Relief Valve: ASME labeled.
 - 2. Wall mounted support.
 - 3. Ball valves and unions at pipe connection points.
 - 4. Ready-Link Communications Cable
 - 5. Condensate drain neutralizer kit piped to floor sink.
 - 6. Coordinate 120 volt outlet for power supply with Electrical Contractor.
 - 7. Provide concentric vent kit.
 - 8. Ready-link wall mount piping manifold.
 - 9. Communication cable to external circulation pump.
- E. Venting: PVC, CPVC or ABS combustion air intake and flue gas outlet with DWV solvent weld fittings per manufacturer's instructions.

2.2 ELECTRONIC DESCALER

- A. Manufacturer:
 - 1. Clear Water Enviro technologies; model Scaleblaster SB-250.
 - 2. Substitutions: Refer to Bidding Requirements and Division 1 - General Requirements.
- B. Electronic descaler to prevent calcium build-up in piping. Install unit on wall next to water heaters, coil wiring installed on cold water supply pipe to water heater per manufacturer's instructions. Coordinate 120 volt outlet for power supply with electrical contractor.
- C. Refer to Plumbing Schedules on plans.

2.3 THERMAL EXPANSION TANKS

- A. Manufacturers:
 - 1. Amtrol Inc.: www.amtrol.com.
 - 2. Wessel Company: www.westank.com.
 - 3. Substitutions: Refer to Bidding Requirements and Division 1 - General Requirements.
- B. Construction: Welded steel, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles. NSF/ANSI 61 listed for potable water.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 40 psig.

2.4 CIRCULATION PUMPS

- A. Manufacturers:
 - 1. ITT Bell & Gossett: www.bellgossett.com.
 - 2. Grundfos Pumps Corporation: www.grundfos.us.

3. Taco Inc: www.tac-hvac.com.
 4. Substitutions: Refer to Bidding Requirements and Division 1 - General Requirements.
- B. Type: Lead free bronze body design, wet rotor circulator with 175 psig maximum working pressure at operating temperature of 225°F continuous. Flanged connections with pump internals capable of being serviced without disturbing piping connections. The manufacturer shall certify all pump ratings. All pumps to operate without excessive noise or vibration.
- C. Refer to Plumbing Schedules on plans.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any. Provide accessories as required for a complete operating system.
- B. Coordinate with plumbing piping and related fuel piping, gas venting, ductwork and electrical work to achieve operating system. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- C. Startup and test equipment adjusting operating and safety controls for proper operation. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies and equipment installations, including connections, and to assist in testing.
- D. Provide accessories as required for a complete operating system.
- E. Domestic water heaters: Pipe relief valves and drains to nearest floor drain, hub drain or floor sink. Install water heater condensate neutralizer kit per manufacturer's recommendations.
- F. Mount commercial tankless water heaters on wall. Adjust and level equipment. Coordinate mounting height with all trades on site to provide required clearance to unit.
- G. Connect equipment to water and drain piping using unions or flanges and isolation valves.
- H. Adjust compression tank pre-charge to scheduled minimum operating pressure prior to connecting to system.
- I. Route water heater venting thru roof and terminate per manufacturer's instructions. Maintain proper code required clearances to openings and mechanical equipment on roof.
- J. Circulating pumps: Provide line sized isolating valve, balancing valve and thermometer on suction and line sized soft seated check valve and balancing isolating valve on discharge.
 1. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitations, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve

3.2 OWNER TRAINING

- A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 1 hour.

END OF SECTION

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SECTION 224000
PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water closets.
- B. Lavatories.
- C. Sinks.
- D. Service sinks.
- E. Electric water coolers.

1.2 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping.
- B. Section 221006 - Plumbing Piping Specialties.
- C. Section 223000 - Plumbing Equipment.
- D. Section 262702 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2006.
- B. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; The American Society of Mechanical Engineers; 1997 (Reaffirmed 2002).
- C. ASME A112.18.1 - Plumbing Supply Fittings; The American Society of Mechanical Engineers; 2005.
- D. ASME A112.19.2 - Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals; The American Society of Mechanical Engineers; 2008.

1.4 SUBMITTALS

- A. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Instructions: Indicate installation methods and procedures.
- C. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

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

1.6 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.

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

1.8 WARRANTY

- A. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements, for additional warranty requirements.

PART 2 PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

- A. Water Closet Manufacturers:
 - 1. American Standard Inc.: www.americanstandard.com.
 - 2. Kohler Company: www.kohler.com.
 - 3. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Water Closets: Vitreous china, ASME A112.19.2, elongated rim wall hung back outlet type, siphon jet flush action, china bolt caps. Flush volume 1.6 gallons. Color white. Refer to Architectural plans for mounting heights.
- C. Flush Valves: ASME A112.18.1, Exposed chrome plated, diaphragm type, complete with vacuum breaker stops and accessories. Vandal resistant stop cap. 1.6 gallon flush volume.
 - 1. Sensor-Operated Type: Sensor-Operated Type: Battery powered, solenoid operator, infrared sensor and over-ride push button.
- D. Flush Valve Manufacturers:
 - a. Sloan Valve Company: www.sloanvalve.com.
 - b. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- E. Seats:
 - 1. Manufacturers:
 - a. Bemis Manufacturing Company: www.bemismfg.com.
 - b. Kohler Company: www.kohler.com.
 - c. Comfort Seats: www.comfort-seat.com.
 - d. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
 - 2. Solid white plastic, open front, extended back, self-sustaining hinge, external check hinge with stainless steel posts, without cover.
- F. Water Closet Carriers: Wall hung
 - 1. Manufacturers:
 - a. Wade Drains: www.wadedrains.com.
 - b. Watts Water Technologies: www.watts.com.
 - c. Zurn Industries, Inc.: www.zurn.com.
 - d. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
 - 2. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.
- G. Refer to Plumbing Fixture Schedule on plans.

2.2 LAVATORY STATION

- A. Lavatory Manufacturers:
 - 1. Bradley Corporation: www.bradleycorp.com.
 - 2. Sloan Valve Company: www.sloanvalve.com.
 - 3. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. 2-station unit: stone resin based solid surface top, stainless steel frame supports and access panels, grid strainer, waste with single P-trap. Center-Shank drillings for two faucets. No soap dispenser. Thermostatic mixing valve assembly with stops and hoses. Unit meets ANSI and ADA accessibility requirements. Refer to Architectural plans for mounting heights.

1. All color options to be available for selection by Architect.

C. Faucet Manufacturers:

1. Sloan Valve Company: www.sloanvalve.com.
2. Bradley Corporation: www.bradleycorp.com.
3. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

D. Faucet: ASME A112.18.1; infrared sensor operated, battery powered, chrome plated, pedestal with base plate, below deck thermostatic mixing valve, 1.5 GPM laminar flow, ADA compliant.

1. Provide Commercial grade quarter turn supply stops with removable handle or loose key.

E. Refer to Plumbing Fixture Schedule on plans.

2.3 SINKS

A. Sink Manufacturers:

1. Elkay Manufacturing: www.elkayusa.com.
2. Advance Tabco: www.advancetabco.com.
3. Just Manufacturing Company: www.justmfg.com.
4. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

B. Classroom Sink Package: Single compartment bowl at 6" deep, ASME A112.19.3; 18 gage thick, Type 304 stainless steel, self rimming and undercoated, with each side and back ledge drilled for trim, includes right side bubbler, left side lever handle and gooseneck faucet at back.

1. Lever handle shall be located on left side, centered on sink bowl. Do not place lever at front left corner of bowl.
2. Bubbler with flexible mouth guard and push button.

C. Laboratory prep sink: Single compartment bowl, ASME A112.19.3; 18 gage thick, Type 304 stainless steel, self rimming and undercoated, with back ledge drilled for trim. Faucet shall have gooseneck spout and ADA complaint lever handles.

D. Supply Faucet Manufacturers:

1. Chicago Faucets: www.chicagofaucets.com.
2. Elkay Manufacturing: www.elkay.com.
3. T & S Brass: www.tsbrass.com.
4. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

E. Accessories for sinks:

1. Commercial grade quarter turn supply stops with removable handle or loose key.
2. Supply lines: rigid chrome plated or flexible stainless steel.
3. Provide below deck thermostatic mixing valve (ASSE 1070) at location indicated on plans.
4. Drain: 3-1/2 inch stainless steel crumb cup and offset tailpiece.
5. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.

F. Refer to Plumbing Fixture Schedule on plans.

2.4 SERVICE SINKS

A. Service Sink Manufacturers:

1. Fiat Products: www.fiat.ca.
2. Florestone, Inc: www.florestone.com.
3. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

B. Bowl: 24 by 24 by 12 inch high, square type, molded stone, floor mounted, 6" drop front with stainless steel threshold and stainless steel flat strainer.

C. Sink Faucet Manufacturers:

1. Fiat Products: www.fiat.ca.

2. Chicago Faucets: www.chicagofaucets.com.
 3. T & S Brass: www.tsbrass.com.
 4. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- D. Trim: ASME A112.18.1 exposed chrome plated wall type supply with lever handles, adjustable spout wall brace, vacuum breaker, hose end spout, pail hook, integral screwdriver stops with covering caps and wall flanges.
1. Provide hose with wall bracket, 3-position mop bracket and stainless steel wall guards.
- E. Refer to Plumbing Fixture Schedule on plans.

2.5 ELECTRIC WATER COOLERS

- A. Electric Water Cooler Manufacturers:
1. Elkay Manufacturing Company: www.elkay.com.
 2. Halsey-Taylor: www.halseytaylor.com.
 3. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Water Cooler: Electric 120/60/1, mechanically refrigerated; wall mounted, handicapped accessible, stainless steel cabinet, vandal-resistant construction, lead free design, water filter, push button operation.
1. Dual height unit with water bottle filling station on lower unit, ADA installation.
 2. Sensor operated bottle fill station.
 3. Provide cane apron on upper unit.
 4. Refer to Architectural plans for mounting heights.
- C. Refer to Plumbing Fixture Schedule on plans.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install plumbing fixtures in accordance with manufacturer's instructions. Set level and plumb. Secure in place to counters, floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping. Cover exposed water closet bolts with bolt covers..
- B. Install each fixture with trap, easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.
- C. Provide chrome plated rigid or stainless steel flexible supplies to fixtures with commercial grade quarter-turn loose key or removable handle stops, reducers, and escutcheons.
- D. Set floor mounted water closets, floor mounted service sinks; counter mounted lavatories and sinks; lavatory and sink faucets and drains with full setting bed of flexible non-staining plumber's putty.
- E. Seal fixtures to wall and floor surfaces with sealant as specified in Division 07, color to match fixture.
- F. Provide unions at water connections and PVC P-traps for electric water coolers.
- G. Cover pipe penetrations with escutcheons. Exposed traps, stops, piping and escutcheons to be chrome plated brass and incased with ADA compliant covers.

- H. Provide adjustable support bracket with pipe clamps for fastening to wall framing to secure piping stub outs at fixtures. Piping stub outs shall be type L copper.

3.4 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components.

3.6 CLEANING

- A. Clean plumbing fixtures and equipment.

3.7 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 RELATED WORK

- A . Section 230513 - Common Motor Requirements for HVAC Equipment.
- B . Section 230593 - Testing, Adjusting, and Balancing for HVAC.
- C . Section 233300 - Air Duct Accessories.

1.2 REFERENCE

- A . Applicable provisions of Division 1 govern work under this section.

1.3 REFERENCE STANDARDS

- A . Abbreviations of standards organizations referenced in other sections are as follows:
 - 1. AABC Associated Air Balance Council.
 - 2. ADC Air Diffusion Council.
 - 3. AGA American Gas Association.
 - 4. AMCA Air Movement and Control Association.
 - 5. ANSI American National Standards Institute.
 - 6. ARI Air Conditioning and Refrigeration Institute.
 - 7. ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers.
 - 8. ASME American Society of Mechanical Engineers.
 - 9. ASTM American Society for Testing and Materials.
 - 10. EPA Environmental Protection Agency.
 - 11. GAMA Gas Appliance Manufacturers Association.
 - 12. IEEE Institute of Electrical and Electronics Engineers.
 - 13. ISA Instrument Society of America.
 - 14. MCA Mechanical Contractors Association.
 - 15. MICA Midwest Insulation Contractors Association.
 - 16. NBS National Bureau of Standards.
 - 17. NEBB National Environmental Balancing Bureau.
 - 18. NEC National Electric Code.
 - 19. NEMA National Electrical Manufacturers Association.
 - 20. NFPA National Fire Protection Association.
 - 21. SMACNA Sheet Metal and Air Conditioning Contractors' National Association. Inc.
 - 22. UL Underwriters Laboratories Inc.
 - 23. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 24. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 25. UL1479 Fire Tests of Through-Penetration Firestops.
 - 26. UL723 Surface Burning Characteristics of Building Materials.

1.4 QUALITY ASSURANCE

- A . Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the performance from the system into which these items are placed. This may include changes found necessary during the testing, adjusting, and balancing phase of the project.

1.5 CONTINUITY OF EXISTING SERVICES

- A . Do not interrupt or change existing services without prior written approval from the Owner Project Representative. When interruption is required, coordinate the down-time with the user agency to minimize disruption to their activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.

1.6 PROTECTION OF FINISHED SURFACES

- A . Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B . Furnish one can of touch-up paint for each different color factory finish which is to be the final finished surface of the product. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

1.7 SLEEVES AND OPENINGS

- A . Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

1.8 SEALING AND FIRESTOPPING

- A . Sealing and firestopping of sleeves/openings between ductwork, piping, etc. and the sleeve, structural or partition opening shall be the responsibility of the Contractor whose work penetrates the opening. The Contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.
- B . Firestopping shall be UL listed and labeled for the actual application.

1.9 SUBMITTALS

- A . Submittals must be reviewed, and approved by submitting Contractor.
- B . Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.
- C . Before submitting electrically powered equipment, verify that the electrical power and control requirements for the equipment are in agreement with the motor starter schedule on the electrical drawings. Include a statement on the shop drawing transmittal to the Engineer that the equipment submitted and the motor starter schedule is in agreement or indicate any discrepancies. See related comments in Section 230513 - Common Motor Requirements for HVAC Equipment in Part 1 under Electrical Coordination.
- D . Include wiring diagrams of electrically powered equipment.
- E . Submit all shop drawings in PDF format with paper copies.
- F . Submit sufficient quantities of printed shop drawings to allow the following distribution:
 - 1. Operating and Maintenance Manuals 2 copies.
 - 2. Testing, Adjusting and Balancing Contractor 1 copy.
 - 3. Owner 1 copy.
 - 4. Architect/Engineer 1 copy.

1.10 OFF SITE STORAGE

- A . Prior approval by Owner and the Architect/Engineer will be needed. The Contractor shall carry insurance for full value, with Owner as beneficiary for consideration of offsite materials storage.
- B . Generally, ductwork, metal for making ductwork, duct lining, sleeves, and similar rough in material will not be accepted for offsite storage. For material that can be stored off site, no material will be accepted for offsite storage unless shop drawings for that material have been approved.

1.11 REQUEST AND CERTIFICATION FOR PAYMENT

- A . Within 10 days after Notice to Proceed, the successful bidder will submit to the Owner Project Representative in a form prescribed below and by the General Conditions of the Contract - Scheduling and Coordination of Work, Reports, Records and Data, Payments to Contractor, a cost breakdown of the proposed values for work performed which, if approved by Owner, will become the basis for construction progress and monthly payments. The cost breakdown items shall reflect actual work progress stages as closely as feasible.
- B . In addition, if payment is requested for approved off-site stored material, then that material shall be listed as a line item in the request and certification for payment cost breakdown.

1.12 CERTIFICATES AND INSPECTIONS

- A . Refer also to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B . Obtain and pay for all required State installation inspections except those provided by the Architect/Engineer. Deliver originals of these certificates to the Division Project Representative. Include copies of the certificates in the Operating and Maintenance Instructions.

1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

- A . Assemble material in three ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the General Requirements, include the following information:
 - 1. Copies of all approved shop drawings.
 - 2. Manufacturer's wiring diagrams for electrically powered equipment.
 - 3. Records of tests performed to certify compliance with system requirements.
 - 4. Certificates of inspection by regulatory agencies.
 - 5. Parts list for manufactured equipment.
 - 6. Lubrication instructions, including list/frequency of lubrication done during construction.
 - 7. Warranties.
 - 8. Additional information as indicated in the technical specification sections.
- B . Provide a PDF file copy of all Operation and Maintenance (O&M) Manuals.

1.14 OWNER TRAINING

- A . Instruct personnel in the proper operation and maintenance of systems and equipment provided as part of this project. Include not less than 4 hours of instruction, using the Operating and Maintenance manuals during this instruction. Demonstrate startup and shutdown procedures for all equipment. All training to be during normal working hours.

1.15 RECORD DRAWINGS

- A . Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B . In addition to the data indicated in the General Requirements, maintain temperature control record drawings on originals prepared by the installing contractor/subcontractor. Include copies of these record drawings with the Operating and Maintenance manuals.

PART 2 PRODUCTS

2.1 ACCESS PANELS AND DOORS

- A . Lay-in Ceilings:
 - 1. Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Division 9 are sufficient; no additional access provisions are required unless specifically indicated.

B . Plaster Walls and Ceilings:

1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

2.2 IDENTIFICATION

A . Stencils:

1. Not less than 1 inch high letters/numbers for marking pipe and equipment.

B . Engraved Name Plates:

1. White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply Style 2060 by Seton Name Plate Company or Emedolite- Style EIP by EMED Co., or equal by Marking Services, or W. H. Brady.

2.3 SEALING AND FIRESTOPPING

A . Non-Rated Penetrations:

1. Duct Penetrations:
 - a. Annular space between duct (with or without insulation) and the non-rated partition or floor opening shall not be larger than 2". Where existing openings have an annular space larger than 2", the space shall be patched to match existing construction to within 2" around the duct.
 - b. Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation. Provide 4" sheet metal escutcheon around duct on both sides of partition or floor to cover annular space.

PART 3 EXECUTION

3.1 BUILDING ACCESS

- A . Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this Contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.2 EQUIPMENT ACCESS

- A . Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance and service. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Access doors in general construction are to be furnished by the Mechanical Contractor and installed by the General Contractor.
- B . Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not require access panels.

3.3 COORDINATION

- A . Verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to, diffusers, register, grilles, and recessed or semi recessed heating and/or cooling terminal units installed in/on architectural surfaces.
- B . Coordinate all work with other Contractors prior to installation. Any installed work that is not coordinated and that interferes with other Contractor's work shall be removed or relocated at the installing Contractor's expense.

- C . Cooperate with the test and balance agency in ensuring Section 230593 specification compliance. Verify system completion to the test and balance agency (clean filters, duct systems cleaned, controls adjusted and calibrated, controls cycled through their sequences, etc.), ready for testing, adjusting and balancing work. Install dampers, gauges, temperature controls, etc., required for functional and balanced systems. Demonstrate the starting, interlocking and control features of each system so the test and balance agency can perform its work.

3.4 IDENTIFICATION

- A . Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black enamel against a light background or white enamel against a dark background. Use a primer where necessary for proper paint adhesion. Do not label equipment such as cabinet heaters and ceiling fans in occupied spaces.
- B . Where stenciling is not appropriate for equipment identification, engraved name plates may be used.
- C . Use engraved name plates to identify control equipment.

3.5 SLEEVES

- A . Duct Sleeves:
 - 1. Duct sleeves are not required in non-rated partitions or floors.
 - 2. Provide sleeve required for fire dampers in fire-rated partitions and floors. Reference fire damper details on drawings.

3.6 SEALING AND FIRESTOPPING

- A . Fire and/or Smoke Rated Penetrations:
 - 1. Install approved product in accordance with the manufacturer's instructions where pipes penetrate a fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier. Provide a UL label at each penetration.
- B . Non-Rated Partitions:
 - 1. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.
 - 2. Duct penetrations through non-rated partitions shall require sheet metal escutcheons with fiberglass or mineral wool insulation fill for spaces that include janitor closets, toilet rooms, mechanical rooms, conference rooms, private consultation rooms, and where noted on drawings elsewhere.

3.7 OWNER TRAINING

- A . All training provided for Owner shall comply with the format, general content requirements and submission guidelines specified.

END OF SECTION

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SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SCOPE

- A . This section includes requirements for single and three phase motors that are used with equipment specified in other sections. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Reference.
 - d. Reference Standards.
 - e. Quality Assurance.
 - f. Shop Drawings.
 - g. Operating and Maintenance Data.
 - h. Electrical Coordination.
 - i. Product Criteria.
 2. PART 2 – PRODUCTS.
 - a. Three Phase, Single Speed Motors.
 - b. Single Phase, Single Speed Motors.
 3. PART 3 – EXECUTION.
 - a. Installation.

1.2 RELATED WORK

- A . Division 26 - Electrical.

1.3 REFERENCE

- A . Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A . ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators.
B . ANSI/NEMA MG-1 Motors and Generators.
C . ANSI/NFPA 70 National Electrical Code.

1.5 QUALITY ASSURANCE

- A . Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

1.6 SHOP DRAWINGS

- A . Include with the equipment which the motor drives the following motor information: Motor manufacturer, horsepower, voltage, phase, hertz, rpm, and full load efficiency. Include project wiring diagrams prepared by the contractor specifically for this work.

1.7 OPERATION AND MAINTENANCE DATA

- A . All operations and maintenance data shall comply with the submission and content requirements specified.

1.8 ELECTRICAL COORDINATION

- A . All starters, overload relay heater coils, disconnect switches and fuses, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are furnished and installed by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.

- B . Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this Contractor, together with their actuating devices if these devices are furnished by the Electrical Contractor. Should any discrepancy in size, horsepower rating, electrical characteristics or means of control be found for any motor or other electrical equipment after contracts are awarded, Contractor is to immediately notify the Architect/Engineer of such discrepancy. Costs involved in any changes required due to equipment substitutions initiated by this contractor will be the responsibility of this contractor. See related comments in Section 230500 - Common Work Results for HVAC, under Shop Drawings.
- C . Electrical Contractor will provide all power wiring and control wiring, except temperature control wiring.
- D . Furnish project specific wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor.

1.9 PRODUCT CRITERIA

- A . Motors to conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by U.L. for the service specified.
- B . Select motors for conditions in which they will be required to perform; i.e., general purpose, standard duty, high torque or any other special type as required by the equipment or motor manufacturer's recommendations.
- C . Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

PART 2 PRODUCTS

2.1 THREE PHASE, SINGLE SPEED MOTORS

- A . Use NEMA rated, three phase, 60 hertz motors for all motors 1/2 HP and larger unless specifically indicated.
- B . Use NEMA general purpose, continuous duty, Design B, normal starting torque, T-frame or U-frame motors with Class B or better insulation unless the manufacturer of the equipment on which the motor is being used has different requirements. Use open drip-proof motors unless totally enclosed fan-cooled motors are specified in the equipment sections.
- C . Use grease lubricated anti-friction ball bearings with housings equipped with plugged/capped provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at the end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- D . All open drip-proof motors to have a 1.15 service factor. Other motor types may have minimum 1.0 service factors.
- E . All motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and smaller, to be high efficiency design with full load efficiencies which meet or exceed the values listed below when tested in accordance with NEMA MG 1.

FULL LOAD NOMINAL MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED

MOTOR HP	-----Open Drip-Proof Motors-----		
	-----Nominal Motor Speed-----		
	1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	77.0
1-1/2	86.5	86.5	84.0
2	87.5	86.5	85.5
3	88.5	89.5	85.5
5	89.5	89.5	86.5
7-1/2	90.2	91.0	88.5

MOTOR HP	----Totally Enclosed Fan-Cooled----		
	-----Nominal Motor Speed-----		
	1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	77.0
1-1/2	87.5	86.5	84.0
2	88.5	86.5	85.5
3	89.5	89.5	86.5
5	89.5	89.5	88.5
7-1/2	91.0	91.7	89.5

2.2 SINGLE PHASE, SINGLE SPEED MOTORS

- A . Use NEMA rated 115 volt, single phase, 60 hertz motors for all motors 1/3 HP and smaller.
- B . Use permanent split capacitor or capacitor start, induction run motors equipped with permanently lubricated and sealed ball or sleeve bearings and Class A insulation. Service factor to be not less than 1.35.

PART 3 EXECUTION

3.1 INSTALLATION

- A . Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to get a secure installation.
- B . When motor will be connected to the driven device by means of a belt drive, mount sheaves on the appropriate shafts in accordance with the manufacturer's instructions. Use a straight edge to check alignment of the sheaves; reposition sheaves as necessary so that the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so that the belt tension is in accordance with the drive manufacturer's recommendations. Frequently recheck belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.
- C . Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any reason.
- D . Lubricate all motors requiring lubrication. Record lubrication material used and the frequency of use. Include this information in the maintenance manuals.

END OF SECTION

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SECTION 230548

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SCOPE

- A . This section includes specifications for vibration isolation material for equipment, piping systems, and duct systems. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Reference.
 - d. Quality Assurance.
 - e. Design Criteria.
 - f. Shop Drawings.
 2. PART 2 – PRODUCTS.
 - a. Materials.
 - b. Type 5: Spring Hanger with Neoprene.
 3. PART 3 – EXECUTION.
 - a. Installation.

1.2 RELATED WORK

- A . Section 233400 - HVAC Fans.

1.3 REFERENCE

- A . Applicable provisions of Division 1 govern work under this section.

1.4 QUALITY ASSURANCE

- A . Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

1.5 DESIGN CRITERIA

- A . Isolate all motor driven mechanical equipment from the building structure and from the systems which they serve to prevent equipment vibrations from being transmitted to the structure.

1.6 SHOP DRAWINGS

- A . Include isolator type and materials of construction.

PART 2 PRODUCTS

2.1 MATERIALS

- A . Use materials that will retain their isolation characteristics for the life of the equipment served. Use industrial grade neoprene for elastomeric materials.

2.2 TYPE 5: SPRING HANGER WITH NEOPRENE

- A . Vibration hanger with a steel spring and 0.3" deflection neoprene element in series. Use neoprene element molded with a rod isolation bushing that passes through the hanger box. Select spring diameters and size hanger box lower holes large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Select springs so they have a minimum additional travel to solid equal to 50% of the rated deflection.

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SCOPE

- A . This section includes air and water testing, adjusting and balancing for the entire project. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Reference.
 - d. Reference Standards.
 - e. Description.
 - f. Quality Assurance.
 - g. Submittals.
 2. PART 2 – PRODUCTS.
 - a. Instrumentation.
 3. PART 3 – EXECUTION.
 - a. Preliminary Procedures.
 - b. Performing Testing, Adjusting and Balancing.
 - c. Deficiencies.

1.2 RELATED WORK

- A . Section 230500 - Common Work Results for HVAC.
- B . Section 230700 - HVAC Insulation.

1.3 REFERENCE

- A . Applicable provisions of the General Conditions, Supplementary General Conditions and General Requirements in Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A . AABC National Standards for Total System Balance, Sixth Edition, 2002.
- B . ASHRAE ASHRAE Handbook, 2007 HVAC Applications, Chapter 37, Testing Adjusting and Balancing.
- C . NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems, Seventh Edition, 2005.

1.5 DESCRIPTION

- A . The Contractor will separately contract with an independent test and balance agency to perform all testing, adjusting, and balancing of air systems required for this project. Work related to the testing, adjusting, and balancing that must be performed by the installing mechanical contractor is specified in other section of these specifications.
- B . Provide total mechanical systems testing, adjusting and balancing. Requirements include the balance of air distribution, adjustment of new and existing systems and equipment to provide design requirements indicated on the drawings, electrical measurement and verification of performance of all mechanical equipment, all in accordance with standards published by AABC or NEBB.
- C . Test, adjust and balance all air systems so that each room, piece of equipment or terminal device meets the design requirements indicated on the drawings and in the specifications.

- D . Accomplish testing, adjusting and balancing work in a timely manner that allows partial occupancy of major buildings, occupancy of one building when the project involves many buildings, and completion of the entire project in the time stated in the Instruction to Bidders and in accordance with the completion schedule established for this project.
- E . Verify that provisions are being made to accomplish the specified testing, adjusting and balancing work. If problems are found, handle as specified in Part 3 under Deficiencies.

1.6 QUALITY ASSURANCE

A . Qualifications:

1. An independent Firm specializing in the Testing and Balancing of HVAC systems for a minimum of 3 years. A Firm not engaged in the commerce of furnishing or providing equipment or material generally related to HVAC work other than specifically related to installing Testing and Balancing components necessary for work in this section such as, but not limited to sheaves, pulleys, and balancing dampers.
2. A certified member of AABC or certified by NEBB in the specific area of work performed. Maintain certification for the entire duration of the project. If certification of firm or any staff performing work is terminated or expires during the duration of the project, contact Owner immediately.
3. Technicians on this project must have satisfactorily completed work on a minimum of (3) three projects of at least 50% in size, and of similar complexity.
4. Submit Qualifications of firm and project staff to Owner upon requested.

1.7 SUBMITTALS

A . See Related Work in this section.

B . Submit testing, adjusting and balancing reports bearing the seal and signature of the NEBB or AABC Certified Test and Balance Supervisor. The reports certify that the systems have been tested, adjusted and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed and are operating; and are an accurate record of all final quantities measured to establish normal operating values of the systems.

C . Submission:

1. Distribute electronic copies of the Report to the Contractor, the Lead Contractor, the Owner, and the Prime Architect/Engineer.

D . Enter a RFI, with a copy of the Testing and Balancing Report Summary as an upload, indicating that the Testing and Balancing Report is posted on the Overview page and requesting review of the report.

1. Format: Cover page identifying project name, project number and descriptive title of contents. Divide the contents of the report into the below listed divisions:
 - a. General Information.
 - b. Summary.
 - c. Air Systems.
2. Contents: Provide the following minimum information, forms and data:
 - a. General Information: Inside cover sheet identifying Test and Balance Agency, Contractor, Architect, Engineer, Project Name and Project Number. Include addresses, contact names and telephone numbers. Also include a certification sheet containing the seal and signature of the Test and Balance Supervisor.
 - b. Summary: Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting and balancing. Provide recommendations for correcting unsatisfactory performances and indicate whether modifications required are within the scope of the contract, are design related or installation related. List instrumentation used during testing, adjusting and balancing procedures.
 - c. The remainder of the report to contain the appropriate standard NEBB or AABC forms for each respective item and system. Fill out forms completely. Where information cannot be obtained or is not applicable indicate same.

PART 2 PRODUCTS

2.1 INSTRUMENTATION

- A . Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements to be in accordance with the requirements of NEBB or AABC Standards and instrument manufacturer's specifications.
- B . All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination by Owner upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB or AABC Standards

PART 3 EXECUTION

3.1 PRELIMINARY PROCEDURES

- A . Review preconstruction meeting report, applicable construction bulletins, applicable change orders, and approved shop drawings of equipment, outlets/inlets and temperature controls.
- B . Check filters for cleanliness, dampers for correct positioning, equipment for proper rotation and belt tension, and temperature controls for completion.
- C . Notify Owner's Project Representative on a daily basis during balancing. Identify deficiencies preventing completion of testing, adjusting and balancing procedures. Do not proceed until systems are fully operational with all components necessary for complete testing, adjusting and balancing. Installing Contractors are required to provide personnel to check and verify system completion, readiness for balancing and assist Balancing Agency in providing specified system performance.

3.2 PERFORMING TESTING, ADJUSTING AND BALANCING

- A . Perform testing, adjusting and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.
- B . Unless specifically instructed in writing, all work in this specification section is to be performed during the normal workday.
- C . In areas containing ceilings, remove ceiling tile to accomplish balancing work; replace tile when work is complete and provide new tile for any tile that are damaged by this procedure. If the ceiling construction is such that access panels are required for the work of this section and the panels have not been provided, inform the Owner's Project Representative.
- D . Cut insulation for installation of test probes to the minimum extent necessary for adequate performance of procedures. Patch using materials identical to those removed, maintaining vapor barrier integrity and pressure rating of systems.
- E . In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.
- F . Measure and record system measurements at the fan to determine total flow. Adjust equipment as required to yield specified total flow at terminals. Proceed taking measurements in mains and branches as required for final terminal balancing. Perform terminal balancing to specified flows balancing branch dampers.
- G . Measure and record static air pressure conditions across fans, coils and filters. Indicate in report if cooling coil measurements were made on a wet or dry coil and if filter measurements were made on a clean or dirty filter. Spot check static air pressure conditions directly ahead of terminal units.
- H . Adjust outside air, return air and relief air dampers for design conditions at both the minimum and maximum settings and record both sets of data. Balance modulating dampers at extreme conditions and record both sets of data. Adjust register, grille and diffuser vanes and

accessories to achieve proper air distribution patterns and uniform space temperatures free from objectionable noise and drafts within the capabilities of the installed system.

- I . Provide fan and motor drive sheave adjustments necessary to obtain design performance. Provide drive changes specifically noted on drawings, if any. If work of this section indicates that any drive or motor is inadequate for the application, advise the Owner's Project Representative by giving the representative properly sized motor/drive information (in accordance with manufacturers original service factor and installed motor horsepower requirements); Confirm any change will keep the duct/piping system within its design limitations with respect to speed of the device and pressure classification of the distribution system. Required motor/drive changes not specifically noted on drawings or in specifications will be considered an extra cost and will require an itemized cost breakdown submitted to Owner's Project Representative. Prior authorization is needed before this work is started.
- J . Final air system measurements to be within the following range of specified cfm:
 - 1. Fans 0% to +10%.
 - 2. Supply grilles, registers, diffusers 0% to +10%.
 - 3. Return/exhaust grilles, registers 0% to -10%.
- K . Contact the Temperature Control Contractor for assistance in operation and adjustment of controls during testing, adjusting and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.
- L . Permanently mark equipment settings, including damper positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.
- M . Leave systems in proper working order, replacing belt guards, closing access doors and electrical boxes, and restoring temperature controls to normal operating settings.
- N . Coordinate furnace and rooftop unit minimum outside air set points with the Temperature Control Contractor.

3.3 DEFICIENCIES

- A . Mechanical Contractor to correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work. Test and balance agency will notify the Owner's Project Representative of these items and instructions will be issued to the Mechanical Contractor for correction of the deficient work. All corrective work to be done at no cost to the Owner. Retest mechanical systems, equipment, and devices once corrective work is complete as specified.

END OF SECTION

SECTION 230700

HVAC INSULATION

PART 1 GENERAL

1.1 SCOPE

- A . This section includes insulation specifications for heating, ventilating and air conditioning piping, ductwork and equipment. Included are the following topics:
 - 1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Reference.
 - d. Reference Standards.
 - e. Quality Assurance.
 - f. Description.
 - g. Definitions.
 - h. Shop Drawings.
 - i. Operation and Maintenance Data.
 - j. Environmental Requirements.
 - 2. PART 2 – PRODUCTS.
 - a. Materials.
 - b. Insulation Types.
 - c. Jackets.
 - d. Accessories.
 - 3. PART 3 – EXECUTION.
 - a. Examination.
 - b. Installation.
 - c. Duct Insulation.

1.2 RELATED WORK

- A . Section 230500 - Common Work Results for HVAC.
- B . Section 233100 - HVAC Ducts and Casings.

1.3 REFERENCE

- A . Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A . ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate.
- B . ASTM C165 Test Method for Compressive Properties of Thermal Insulations.
- C . ASTM C177 Heat Flux and Thermal Transmission Properties.
- D . ASTM C355 Test Methods for Test for Water Vapor Transmission of Thick Materials.
- E . ASTM C518 Heat Flux and Thermal Transmission Properties.
- F . ASTM C921 Properties of Jacketing Materials for Thermal Insulation.
- G . ASTM C1136 Flexible Low Permeance Vapor Retarders for Thermal Insulation.
- H . ASTM D1000 Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
- I . ASTM E84 Surface Burning Characteristics of Building Materials.
- J . ASTM E814 Standard Test Method for Fire Tests of Penetration Firestop Systems.

- K . MICA National Commercial & Industrial Insulation Standards.
- L . NFPA 225 Surface Burning Characteristics of Building Materials.
- M . UL 723 Surface Burning Characteristics of Building Materials.

1.5 QUALITY ASSURANCE

- A . Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B . Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C . Insulation systems shall be applied by experienced contractors. Within the past five (5) years, the Contractor shall be able to document the successful completion of a minimum of three (3) projects of at least 50% of the size and similar scope of the work specified in this section.

1.6 DESCRIPTION

- A . Furnish and install all insulating materials and accessories as specified or as required for a complete installation. The following types of insulation are specified in this section:
 - 1. Duct Insulation.
- B . Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only be accepted where specifically modified in these specifications, or where prior written approval has been obtained from the Owner Project Representative.

1.7 DEFINITIONS

- A . Concealed: Shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

1.8 SHOP DRAWINGS

- A . Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.9 OPERATION AND MAINTENANCE DATA

- A . All operations and maintenance data shall comply with the submission and content requirements specified.

1.10 ENVIRONMENTAL REQUIREMENTS

- A . Do not store insulation materials on grade or where they are at risk of becoming wet. Do not install insulation products that have been exposed to water.
- B . Protect installed insulation work with plastic sheeting to prevent water damage.

PART 2 PRODUCTS

2.1 MATERIALS

- A . Manufacturers:
 - 1. Armacell: www.armacell.com.
 - 2. Certainteed: www.certainteed.com.
 - 3. Johns Manville: www.johnsmanville.com.
 - 4. Knauf: www.knaufusa.com.
 - 5. Owens-Corning: www.insulation.owens-corning.com.
 - 6. VentureTape: www.venturetape.com.

- B . Materials or accessories containing asbestos will not be accepted.

2.2 INSULATION TYPES

- A . Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.
- B . Flexible Fiberglass Insulation:
 - 1. Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.3 at 75 degrees F, rated for service to 250 degrees F.
- C . Rigid Fiberglass Insulation:
 - 1. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.
- D . Foil-scrim-polyethylene vapor barrier jacket, factory applied to insulation, maximum permeance of .02 perms.

2.3 JACKETS

- A . Foil Scrim All Service Jackets (FSJ):
 - 1. Glass fiber reinforced foil kraft laminate, factory applied to insulation. Maximum permeance of .02 perms and minimum beach puncture resistance of 25 units.

2.4 ACCESSORIES

- A . All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B . Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C . Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015 inch for aluminum and .010 inch for stainless steel.
- D . Tack fasteners to be stainless steel ring grooved shank tacks.
- E . Staples to be clinch style.
- F . Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.
- G . Finishing cement to be ASTM C449.
- H . Bedding compounds to be non-shrinking and permanently flexible.
- I . Vapor barrier coatings to have maximum applied water vapor permeance of .05 perms.
- J . Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

PART 3 EXECUTION

3.1 EXAMINATION

- A . Verify that all piping, equipment, and ductwork are tested and approved prior to installing insulation. Do not insulate systems until testing and inspection procedures are completed.
- B . Verify that all surfaces are clean, dry and without foreign material before applying insulation materials.

3.2 INSTALLATION

- A . All materials shall be installed by skilled labor regularly engaged in this type of work. All materials shall be installed in strict accordance with manufacturer's recommendations, building codes, and industry standards. Do not install products when the ambient

temperature or conditions are not consistent with the manufacturer's recommendations. Surfaces to be insulated must be clean and dry.

- B . Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation.
- C . Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- D . Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.
- E . All duct insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or firesafing materials are required. Vapor barriers shall be maintained continuous through all penetrations.
- F . Provide a continuous unbroken moisture vapor barrier on insulation applied to systems noted below. Attachments to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- G . Provide a complete vapor barrier for insulation on the following systems:
 - 1. Insulated Duct.
 - 2. Equipment, ductwork or piping with a surface temperature below 65 degrees F.

3.3 DUCT INSULATION

- A . General:
 - 1. Secure flexible duct insulation on sides and bottom of ductwork over 24" wide and all rigid duct insulation with weld pins. Space fasteners 18" on center or less as required to prevent sagging.
 - 2. Secure rigid board insulation to ductwork with weld pins. Apply insulation with joints firmly butted as close as possible to the equipment surface. Pins shall be located a maximum of 3" from each edge and spaced no greater than 12" on center.
 - 3. Install weld pins without damage to the interior galvanized surface of the duct. Clip pins back to washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4" tape of same material as jacket. Seal tape with plastic applicator and secure with staples. All joints, seams, edges and penetrations to be fully vapor sealed.
 - 4. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.
 - 5. External supply duct insulation is not required where ductwork contains continuous 1" acoustical liner. Provide 4" overlap of external insulation over ends of acoustically lined sections.
 - 6. Where insulated ductwork is supported by trapeze hangers, the insulation shall be installed continuous through the hangers. Drop the supporting channels required to facilitate the installation of the insulation. Where rigid board or flexible insulation is specified, install high density inserts to prevent the weight of the ductwork from crushing the insulation.

END OF SECTION

SECTION 233100

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SCOPE

- A . This section includes specifications for all duct systems used on this project. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Reference.
 - d. Reference Standards.
 - e. Shop Drawings.
 - f. Design Criteria.
 - g. Delivery, Storage and Handling.
 2. PART 2 – PRODUCTS.
 - a. General.
 - b. Duct Pressure Class.
 - c. Materials.
 - d. Low Pressure Ductwork (Maximum 2 inch pressure class).
 - e. Duct Sealant.
 - f. Gaskets.
 3. PART 3 – EXECUTION.
 - a. Installation.
 - b. Ductwork Support.
 - c. Low Pressure Duct (Maximum 2 inch pressure class).
 - d. Cleaning.

1.2 RELATED WORK

- A . Section 230593 - Testing, Adjusting, and Balancing for HVAC.
B . Section 233300 - Air Duct Accessories.

1.3 REFERENCE

- A . Applicable provisions of Division 1 govern work under this Section.

1.4 REFERENCE STANDARDS

- | | |
|-----------------|--|
| A . ASTM A90 | Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles. |
| B . ASTM A623 | Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process. |
| C . ASTM A527 | Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality. |
| D . ASTM 924 | Standard Specification for General Requirements for Sheet Steel, Metallic-coated by the Hot-dip Method. |
| E . ASTM C 1071 | Specification for Fibrous Glass Duct Lining Insulation. |
| F . ASTM E 84 | Test Method for Surface Burning Characteristics of Building Materials. |
| G . ASTM C 1338 | Test Method for Determining Fungal Resistance of Insulation Materials and Facings. |
| H . ASTM C 916 | Standard Specification for Adhesives for Duct Thermal Insulation |

NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.

I . UL 181 Standard for Safety for Factory Made Air Ducts and Air Connectors.

J . NAIMA Fibrous Glass Duct Liner Standard.

1.5 SHOP DRAWINGS

A . Include manufacturer's data and/or Contractor data for the following:

1. Duct sealant and gasket material.
2. Duct liner including data on thermal conductivity, air friction correction factor, and limitation on temperature and velocity.

1.6 DESIGN CRITERIA

A . Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.

B . Use material, weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA publications, unless noted otherwise:

1. HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005.
2. HVAC Air Duct Leakage Test Manual, 1st Edition, 1985.
3. HVAC Systems - Duct Design, 4th Edition, 2006.
4. Rectangular Industrial Duct Construction Standard, 2nd Edition, 2004.
5. Round Industrial Duct Construction Standards, 2nd Edition, 1999.

C . Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

1.7 DELIVERY, STORAGE AND HANDLING

A . Promptly inspect shipments to ensure that Ductwork is undamaged and complies with the specification.

B . Protect Ductwork against damage.

C . Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end caps/packaging are provided, take precautions so caps/packaging remain in place and free from damage.

D . Offsite storage agreements do not relieve the contractor from using proper storage techniques.

E . Storage and protection methods must allow inspection to verify products.

PART 2 PRODUCTS

2.1 GENERAL

A . All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral ductwork and spiral duct take-offs 12" and below may be 26 gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005.

B . Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.

2.2 DUCTWORK PRESSURE CLASS

A . Minimum acceptable duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G. positive or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure class is 1 inch W.G. positive or negative, depending on the application.

2.3 MATERIALS

A . Galvanized Steel Sheet:

1. Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces per square foot, both sides of sheet, G90 in accordance with ASTM A90. Provide "Paint Grip" finish for ductwork that will be painted.

2.4 LOW PRESSURE DUCTWORK (MAXIMUM 2 INCH PRESSURE CLASS)

- A . Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as modified below.
- B . Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.
- C . Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in accordance with SMACNA publications, Type RE 3. Where space will not allow and the C value of the radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in Section 233300. Square throat-radius heel elbows will not be acceptable. Straight taps or bullhead tees are not acceptable.
- D . Where rectangular elbows are used, provide turning vanes in accordance with Section 233300.
- E . Provide expanded take-offs or 45 degree entry fittings for branch duct connections with branch ductwork airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not be accepted.
- F . Button punch snaplock construction will not be accepted on aluminum ductwork.
- G . Round ducts may be substituted for rectangular ducts if sized in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission of the Architect/Engineer. All uninsulated exposed round duct shall be spiral type.
- H . Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

2.5 DUCT SEALANT

A . Manufacturer:

1. 3M 800: www.3m.com.
2. 3M 900: www.3m.com.
3. H.B. Fuller/Foster: www.hbfuller.com.
4. Lockformer Cold Sealant: www.lockformer.com.
5. Mon-Eco Industries: www.mon-ecoindustries.com.
6. United Sheet Metal: www.unitedsheetmetal.com.

B . Silicone sealants are not allowed in any type of ductwork installation.

- C . Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.

2.6 GASKETS

A . 2 inch pressure class and lower:

1. Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.

PART 3 EXECUTION

3.1 INSTALLATION

- A . Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with Architect in the event of any interference.
- B . Make allowances for beams, pipes or other obstructions in building construction and for work of other Contractors. Transform, divide or offset ducts as required, in accordance with SMACNA HVAC Duct Construction Standards, Figure 4-7, except do not reduce duct to less than six inches in any dimension and do not exceed an 8:1 aspect ratio. Where it is necessary to take pipes or similar obstructions through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards, Figure 4-8, Fig. E. In all cases, seal to prevent air leakage. Pipes or similar obstructions may not pass through high pressure or fume exhaust ductwork.
- C . Test openings for test and balance work will be provided under Section 230593.
- D . Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in duct systems, and make all connections to such equipment including equipment furnished by others. Secure frames with gaskets and screws or nut, bolts and washers.
- E . Install duct to pitch toward outside air intakes and drain to outside of building. Solder or seal seams to form watertight joints.
- F . Install all motor operated dampers and connect to or install all equipment furnished by others. Blank off all unused portions of louvers, as indicated on the drawings, with 1-1/2 inch board insulation with galvanized sheet metal backing on both sides.
- G . Do not install ductwork through dedicated electrical rooms or spaces unless the ductwork is serving this room or space.
- H . Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- I . Provide adequate access to ductwork for cleaning purposes.
- J . Provide temporary capping of ductwork openings to prevent entry of dirt, dust and foreign material.
- K . Protect diffusers, registers and grilles with plastic wrap or some other approved form of protection to maintain dirt and dust free and to prevent entry of dirt, dust and foreign material into the Ductwork.
- L . During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.2 DUCTWORK SUPPORT

- A . Support ductwork in accordance with SMACNA HVAC Duct Construction Standards, Figure 5-5, except supporting ductwork with secure wire method is not allowed.
- B . Support with 3/32 inch, 7 x 7, stainless steel air-craft cable, with matching fastener rated for 50% of actual load, will be allowed on round ductwork under 12 inches if installed as detailed, with cable double looped on duct and at point of support.

3.3 LOW PRESSURE DUCT (MAXIMUM 2 INCH PRESSURE CLASS)

- A . Seal all duct, with the exception of transfer ducts, in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.
- B . Install a manual balancing damper in each branch duct and for each diffuser or grille. The use of splitter dampers, extractors, or grille face dampers will not be accepted for balancing dampers.

C . Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheet metal screws or pop rivets. Trapeze hangers may be used at Contractor's option.

3.4 CLEANING

A . Remove all dirt and foreign matter from the entire duct system and clean diffusers, registers, grilles and the inside of air-handling units before operating fans.

B . Clean duct systems with high power vacuum machines where systems have been used for temporary heat, air-conditioning, or ventilation purposes during construction. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.

END OF SECTION

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SECTION 233300

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SCOPE

- A . This section includes accessories used in the installation of duct systems. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Related Work.
 - b. Reference.
 - c. Reference Standards.
 - d. Shop Drawings.
 - e. Operation and Maintenance Data.
 2. PART 2 – PRODUCTS.
 - a. Manual Volume Dampers.
 - b. Turning Vanes.
 - c. Control Dampers.
 - d. Smoke Detectors.
 - e. Access Doors.
 - f. Flexible Duct.
 - g. Duct Lining.
 - h. Duct Flexible Connections.
 - i. Hoods for Intake and Exhaust.
 3. PART 3 – EXECUTION.
 - a. Manual Volume Dampers.
 - b. Turning Vanes.
 - c. Control Dampers.
 - d. Smoke Detectors.
 - e. Access Doors.
 - f. Flexible Duct.
 - g. Duct Lining.
 - h. Duct Flexible Connections.
 - i. Hoods for Intake and Exhaust.

1.2 RELATED WORK

- A . Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
B . Section 233100 - HVAC Ducts and Casings.

1.3 REFERENCE

- A . Applicable provisions of Division 1 govern work under this Section.

1.4 REFERENCE STANDARDS

- A . NFPA 90A Standard for Installation of Air Conditioning and Ventilating Systems.
B . SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition, 1995.
UL 214.
C . UL 555 (6th edition) Standard for Fire Dampers and Ceiling Dampers.

1.5 SHOP DRAWINGS

- A . Submit for all accessories and include dimensions, capacities, ratings, installation instructions, and appropriate identification.

- B . Include certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance of sound attenuators.
- C . Submit manufacturer's color charts where finish color is specified to be selected by the Engineer.

1.6 OPERATION AND MAINTENANCE DATA

- A . All operations and maintenance data shall comply with the submission and content requirements specified.

PART 2 PRODUCTS

2.1 MANUAL VOLUME DAMPERS

- A . Manufacturers:
 - 1. Ruskin: www.ruskin.com.
 - 2. Vent Products: www.ventproducts.com.
 - 3. Air Balance: www.airbalance.com.
- B . Dampers must be constructed in accordance with SMACNA Fig. 2-12, Fig. 2-13, and notes relating to these figures, except as modified below.
- C . Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections with mullions where width is over 48 inches. Use rivets or tack welds to secure individual components; sheet metal screws will not be accepted. Provide operators with locking devices and damper position indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or bushings for all volume damper rods penetrating ductwork constructed to a 3" w.c. pressure class or above.

2.2 TURNING VANES

- A . Manufacturers:
 - 1. Aero Dyne: www.aero-dyne.net.
 - 2. Anemostat: www.anemostat.com.
 - 3. Hart & Cooley: www.hartandcooley.com.
- B . Construct turning vanes and runners for square elbows in accordance with SMACNA Fig. 2-3 and Fig. 2-4 except use only airfoil type vanes. Construct turning vanes for short radius elbows and elbows where one dimension changes in the turn in accordance with SMACNA Fig. 2-5 and Fig. 2-6.

2.3 CONTROL DAMPERS

- A . Control dampers are integral to the packaged rooftop units and exhaust fans. New dampers for Furnace outside air control shall be provided and installed by the Mechanical Contractor. Wiring for dampers shall be by the Mechanical Contractor.

2.4 ACCESS DOORS

- A . Access door to be designed and constructed for the pressure class of the duct in which the door is to be installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be steel full length continuous piano type. Doors in concealed spaces may be secured in place with cam sash latches. For both hinged and non-hinged doors provide sufficient number of cam sash latches to provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict access. Use minimum 1" deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1" deep double wall access door with frame that shall use materials of construction identical to adjacent ductwork. Provide double neoprene gasket that shall provide seals from the frame to the door and frame to the duct. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners will not be accepted.

2.5 FLEXIBLE DUCT

- A . Manufacturers:
 - 1. Anco Products: www.ancoproductsinc.com.
 - 2. Clevaflex: www.clevaflex.com.
 - 3. Thermafex: www.thermafex.net.
 - 4. Flexmaster: www.flexmasterusa.com.
- B . Factory fabricated , UL 181 listed as a class 1 duct, and having a flame spread of 25 or less and smoke developed rating of 50 or under in accordance with NFPA 90A.
- C . Suitable for pressures and temperatures involved but not less than a 180°F service temperature and ± 2 inch pressure class, depending on the application.
- D . Duct to be composed of polyester film, aluminum laminate or woven and coated fiberglass fabric bonded permanently to corrosion resistant coated steel wire helix. Two-ply, laminated, and corrugated aluminum construction may also be used.
- E . Where duct is specified to be insulated, provide a minimum 1 inch fiberglass insulation blanket with maximum thermal conductance of 0.23 K (75 degrees F.) and vapor barrier jacket of polyethylene or metalized reinforced film laminate. Maximum perm rating of vapor barrier jacket to be 0.1 perm.

2.6 DUCT LINING

- A . Manufacturer:
 - 1. Manville: www.jm.com.
 - 2. Owens-Corning: www.owenscorning.com.
 - 3. Knauf: www.knaufusa.com.
- B . 1 inch thick, flexible, mat faced insulation made from inorganic glass fibers bonded with a thermosetting resin with thermal conductivity of .25 Btu inch / hour sq.ft. deg F.
- C . Meet erosion testing per UL 181 or ASTM C 1071 for 5000 fpm maximum air velocity. ASTM C 411 maximum operating temperature rating of 250 deg F. ASTM E84 flame spread less than 25 and smoke developed less than 50.
- D . Meet requirements of ASTM C 1338 and ASTM G21 for fungi resistance.
- E . Install liner using adhesive conforming to ASTM C 916.

2.7 DUCT FLEXIBLE CONNECTIONS

- A . Material to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.
- B . Connections to be a minimum of 3 inches wide, crimped into metal edging strip, and air tight. Connections to have adequate flexibility and width to allow for thermal expansion/contraction, vibration of connected equipment, and other movement.
- C . Use coated glass fiber fabric for all applications. Material for inside applications to be double coated with neoprene, air and water tight, suitable for temperatures between -10°F and 200°F, and have a nominal weight of 30 ounces per square yard.

2.8 HOODS FOR INTAKE AND EXHAUST

- A . Manufacturers:
 - 1. Acme: www.acmefan.com.
 - 2. Carnes: www.carnes.com.
 - 3. Cook: www.lorencook.com.
 - 4. Greenheck: www.greenheck.com.
 - 5. Louvers and Dampers: www.louvers-dampers.com.
 - 6. Penn: www.pennstateind.com.

7. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

- B . Use low silhouette type hoods.
- C . Use louvered penthouse type hoods with drainable blade louvers.
- D . Construct hoods of aluminum.
- E . Construct hoods of galvanized steel with baked enamel finish; color to be selected by the Architect during the submittal stage.

For hoods and louvered penthouses maintain minimum 30 inches from bottom of air intake to finished roof.

- F . Provide bird screen and motor operated damper for each hood.

PART 3 EXECUTION

3.1 MANUAL VOLUME DAMPERS

- A . Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away from the outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter or vibration of the damper blade(s).

3.2 TURNING VANES

- A . Install turning vanes in all rectangular, mitered elbows in accordance with SMACNA standards and/or manufacturer's recommendations.
- B . Install double wall, airfoil, 2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity less than 2000 fpm. Install double wall, airfoil, 4-1/2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity 2000 fpm or greater.
- C . If duct size changes in a mitered elbow, use single wall type vanes with a trailing edge extension. If duct size changes in a radius elbow or if short radius elbows must be used, install sheetmetal turning vanes in accordance with SMACNA Figure 2-5 and Figure 2-6.

3.3 ACCESS DOORS

- A . Install access doors where specified, indicated on the drawings, and in locations where maintenance, service, cleaning or inspection is required. Examples include, but are not limited to motorized dampers, fire dampers, smoke detectors, fan bearings, heating and cooling coils, filters, and control devices needing periodic maintenance.
- B . Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum access door size shall be 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, or other size as indicated.

3.4 FLEXIBLE DUCT

- A . Flexible duct may only be used for final connections of air outlets at diffuser, register, and grille locations. Where flexible duct is used, it shall be the minimum length required to make the final connections, but no greater than 5 feet in length, and have no more than one (1) 90 degree bend.
- B . Secure inner jacket of flexible duct in place with stainless steel metal band clamp. Secure insulation vapor barrier jacket in place with steel or nylon draw band. Sheetmetal screws and/or duct tape will not be accepted.
- C . Flexible duct used to compensate for misalignment of main duct or branch duct will not be accepted.
- D . Individual sections of flexible ductwork shall be of one piece construction. Splicing of short sections will not be accepted.

- E . Flexible ductwork used as transfer duct shall be sized for a maximum velocity of 300 fpm.
- F . Penetration of any partition, wall, or floor with flexible duct will not be accepted.

3.5 DUCT LINING

- A . Do not apply lining to the following ductwork:
 - 1. Outside air ductwork.
- B . Install liner in compliance with the latest edition of NAIMA's Fibrous Glass Duct Liner Standard. Locate longitudinal joints at the corners of duct only. Cut and fit to assure lapped, compressed joints. Coat all transverse and longitudinal joints and edges with adhesive. Provide metal nosing on leading edge where lined duct is preceded by unlined duct. Adhere liner to duct with full coverage area of adhesive. Additionally, secure liner to duct using mechanical fasteners spaced as recommended by the liner manufacturer without compressing liner more than 1/8" with the fasteners.

3.6 DUCT FLEXIBLE CONNECTIONS

- A . Install at all duct connections to rotating or vibrating equipment, including air handling units (unless unit is internally isolated), fans, or other motorized equipment in accordance with SMACNA Figure 2-19. Install thrust restraints to prevent excess strain on duct flexible connections at fan inlets and outlets; see Related Work.

3.7 HOODS FOR INTAKE AND EXHAUST

- A . Install in locations indicated on the drawings, coordinating the roof opening location with the General Contractor.

END OF SECTION

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SECTION 233400

HVAC FANS

PART 1 GENERAL

1.1 SCOPE

- A . This section includes specifications for fans that are not an integral part of a manufactured device. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Reference.
 - d. Reference Standards.
 - e. Shop Drawings.
 - f. Operation and Maintenance Data.
 - g. Design Criteria.
 2. PART 2 – PRODUCTS.
 - a. General.
 - b. Power Roof Exhaust Fans.
 3. PART 3 – EXECUTION.
 - a. Installation.

1.2 RELATED WORK

- A . Section 230513 - Common Motor Requirements for HVAC Equipment.
- B . Section 230548 - Vibration and Seismic Controls for HVAC Piping and Equipment.

1.3 REFERENCE

- A . Applicable provisions of Division 1 govern work under this Section.

1.4 REFERENCE STANDARDS

- A . AMCA 203 AMCA Fan Application Manual – Troubleshooting.
- B . AMCA 210 Laboratory Method of Testing Fans for Rating.
- C . AMCA 300 Reverberant Room Method for Sound Testing of Fans.
- D . NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.

1.5 SHOP DRAWINGS

- A . Include dimensions, capacities, fan curves, materials of construction, ratings, weights, motors and drives, sound power levels, appropriate identification and vibration isolation for all equipment. Sound power levels to be based on tests performed in accordance with AMCA Standard 300.
- B . Submit color selection charts for equipment where applicable.
- C . Fan curves shall indicate the relationship of CFM to static or total pressure for various fan speeds. Brake horsepower, recommended selection range, and limits of operation are to also be indicated on the curves. Indicate operating point on the fan curves at design air quantity and indicate the manufacturer's recommended drive loss factor for the specific application. Tabular fan performance data is not acceptable.

1.6 OPERATION AND MAINTENANCE DATA

- A . All operations and maintenance data shall comply with the submission and content requirements specified.

1.7 DESIGN CRITERIA

- A . Tested and certify all fans in accordance with the applicable AMCA test code.
- B . Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.
- C . Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.
- D . Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven airflow or improve mixing.
- E . All internal insulation and other components exposed to the airstream are to meet the flame spread and smoke ratings contained in NFPA 90A.

PART 2 PRODUCTS

2.1 GENERAL

- A . Use fan size, class, type, arrangement, and capacity as scheduled.
- B . Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and accessories required for specified performance and proper operation. All single phase motors to have inherent thermal overload protection.
- C . Provide variable pitch sheaves for drives 3 hp and smaller. Design all drives for 150% of motor rating.
- D . Use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded metal to allow for ventilation; provide tachometer openings at shaft locations.
- E . Statically and dynamically balance all fans so they operate without objectionable noise or vibration.

2.2 POWER ROOF EXHAUST FANS

- A . Manufacturers:
 - 1. Carnes: www.carnes.com.
 - 2. Greenheck: www.greenheck.com.
 - 3. Penn: www.pennstateind.com.
 - 4. Jenn-Air: www.jennair.com.
 - 5. Cook: www.lorencook.com.
 - 6. ACME: www.acmefan.com.
 - 7. Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B . Provide upblast or downblast units, as scheduled, with aluminum housing, non-overloading type centrifugal wheel, inlet cone, factory mounted and wired motor and disconnect switch, and bird screen.
- C . Electrical Contractor will provide disconnect switches and thermal overload protection for units with three phase motors.
- D . This must be coordinated with the electrical specifications and the electrical designer.
- E . Upblast units to have motor, bearings, and drives completely enclosed and isolated from the exhaust air stream with ventilation provided by outside air. Units handling grease laden vapors to be U.L. listed for conveying such vapors, operating continuously at 300 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

A . Install as detailed, and according to manufacturer's installation instructions.

END OF SECTION

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SECTION 233713

DIFFUSERS, REGISTERS AND GRILLES

PART 1 GENERAL

1.1 SCOPE

- A. This section includes specifications for air terminal equipment. Included are the following topics:
 - 1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Reference.
 - d. Reference Standards.
 - e. Submittals.
 - f. Design Criteria.
 - 2. PART 2 – PRODUCTS.
 - a. Manufacturers.
 - b. Square Ceiling Diffusers - High Performance.
 - c. Eggcrate Grille.
 - 3. PART 3 – EXECUTION.
 - a. Installation.

1.2 RELATED WORK

- A. Section 230593 - Testing, Adjusting and Balancing for HVAC.
- B. Section 233100 - HVAC Ducts and Casings.
- C. Section 233300 - Air Duct Accessories.

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. UL 181 - Factory-Made Air Ducts and Connectors.
- C. ARI-ADC Standard 880.

1.5 SUBMITTALS

- A. Furnish submittal information including, but not limited to, the following:
 - 1. Manufacturer's name and model number.
 - 2. Identification as referenced in the documents.
 - 3. Capacities/ratings.
 - 4. Materials of construction.
 - 5. Sound ratings.
 - 6. Dimensions.
 - 7. Finish.
 - 8. Color selection charts where applicable.
 - 9. Manufacturer's installation instructions.
 - 10. All other appropriate data.

1.6 DESIGN CRITERIA

- A. All performance data shall be based on tests conducted in accordance with Air Diffusion Council (ADC) Test Code 1062 GRD 84.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Carnes: www.carnes.com.
- B. Krueger: www.krueger-hvac.com.
- C. Titus: www.titus-hvac.com.
- D. Metal-Aire: www.metalaire.com.
- E. E.H. Price: www.price-hvac.com.
- F. Acceptable manufacturers for specific products are listed under each item.

2.2 SQUARE CEILING DIFFUSERS - HIGH PERFORMANCE

- A. Diffusers to be steel unless otherwise indicated, louvered face furnished with frame type appropriate to installation.
- B. Diffuser shall have throw characteristics of a round diffuser having a 360° horizontal blow pattern.
- C. Louver cones shall be one-piece construction with no corner joints.
- D. White, baked enamel finish or powder coat finish, unless otherwise indicated.
- E. High performance type diffuser incorporating short throws and low NC levels.
- F. Manufacturers:
 - 1. Titus; Model TMS: www.titus-hvac.com.
 - 2. Carne; Series SF: www.carnes.com.
 - 3. Price; Model SCD: www.price-hvac.com.
 - 4. Metal Aire; Series 5800: www.metalaire.com.
 - 5. Krueger; Series 1400: www.krueger-hvac.com.

2.3 EGGCRATE GRILLE

- A. Aluminum construction with frame type appropriate to installation.
- B. Grille face 1/2" x 1/2" or 1" x 1" grid pattern 1" deep with a minimum of 85% free area.
- C. Grille sizes and finishes as shown on drawings and/or as scheduled.
- D. White, baked enamel finish or powder coat finish, unless otherwise indicated.
- E. Screw holes on surface counter sunk to accept recessed type screws.
- F. Manufacturers:
 - 1. Titus; Model 50: www.titus-hvac.com.
 - 2. Carnes; Model RAE or RAT: www.carnes.com.
 - 3. Price; Model 80: www.price-hvac.com.
 - 4. Metal Aire; Model CC: www.metalaire.com.
 - 5. Krueger; Model EGC: www.krueger-hvac.com.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install grilles, registers and diffusers as shown on drawings and according to manufacturer's instructions.
- B. Furnish diffusers with equalizing grids where it is not possible to maintain minimum 2 duct diameter straight duct into diffuser. Equalizing grids shall consist of individually adjustable vanes designed for equalizing airflow into diffuser neck and providing directional control of airflow.

- C. Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar size.
- D. Seal connections between ductwork drops and diffusers/grilles airtight.
- E. Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat black paint to reduce visibility.

END OF SECTION

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SECTION 235400
GAS FIRED FURNACES

PART 1 GENERAL

1.1 SCOPE

- A . This section includes specifications for gas fired furnaces. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Reference.
 - d. Reference Standards.
 - e. Energy Efficiency.
 - f. Submittals.
 - g. Operation and Maintenance Data.
 - h. Warranty.
 2. PART 2 – PRODUCTS.
 - a. Furnaces.
 3. PART 3 – EXECUTION.
 - a. Installation.
 - b. Furnaces.
 - c. Owner Training.

1.2 RELATED WORK

- A . Section 230513 - Common Motor Requirements for HVAC Equipment.

1.3 REFERENCE

- A . Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A . AGA American Gas Association.
B . ANSI Z21.64 Direct Vent Central Furnaces.
C . GAMA Gas Appliance Manufacturers Association.
D . NEC National Electrical Code.

1.5 ENERGY EFFICIENCY

- A . Provide gas furnaces that bear the ENERGY STAR label and meet the ENERGY STAR specifications for energy efficiency.

1.6 SUBMITTALS

- A . Include specific manufacturer and model numbers, equipment identification corresponding to project drawings and schedules, dimensions, capacities, materials of construction, ratings, weights, power requirements and wiring diagrams, filter information and information for all accessories.

1.7 OPERATION AND MAINTENANCE DATA

- A . All operations and maintenance data shall comply with the submission and content requirements specified.

1.8 WARRANTY

- A . Furnace primary and secondary heat exchangers warranted for 20 years under normal use and maintenance. Remainder of furnace components warranted for 1 year from date of start up.

PART 2 PRODUCTS

2.1 FURNACES

- A . Manufacturers:
 - 1. Carrier: www.carrier.com.
 - 2. Lennox: www.lennox.com.
 - 3. York: www.york.com.
- B . Substitutions: Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements. Direct vent, sealed combustion, condensing type AGA certified for use with natural gas. Minimum annual fuel utilization efficiency (A.F.U.E.) of 91. All ratings are to be certified by GAMA. All wiring shall comply with the National Electrical Code.
- C . 22 gauge steel casing with baked enamel finish or pre-painted galvanized steel. Insulate casing back and side panels with foil faced fiberglass insulation.
- D . Construct primary heat exchanger of aluminized steel. Construct secondary heat exchanger of stainless steel with aluminum fins or of polypropylene laminated steel. Aluminized steel multi-port in-shot burner with hot surface or electronic spark ignition, approved for vertical or sidewall venting.
- E . AGA listed gas controls including manual main shut-off valve, double automatic gas valves for redundancy and gas pressure regulator.
- F . Centrifugal type blower fan statically and dynamically balanced with multiple speed, direct drive or belt drive fan motor. Provide low energy induced draft blower for heat exchanger prepurge and combustion gas venting.
- G . Provide unit with 2" thick MERV 8 minimum disposable type panel air filter and filter holding rack.
- H . Provide solid state integral control unit with all necessary controls and relays including but not limited to:
 - 1. Pressure switch for airflow of flue products through furnace and out vent system.
 - 2. Rollout switch with manual reset to prevent over temperature in burner area.
 - 3. Electronic flame sensor.
 - 4. Blower access safety interlock.
 - 5. Timed blower start after main burners ignite.
 - 6. Factory installed 24 v transformer for controls and thermostat.
 - 7. LED's to indicate status and to aid in troubleshooting.
- I . Provide unit with matching cased "A" configuration cooling coil for upflow units, and vertical flat face configuration cooling coil for horizontal units.
- J . Minimum 1/2" OD seamless copper tubing mechanically bonded to heavy ripple edged aluminum fins with thermal expansion valve, holding charge and copper tube stubs for field piping.
- K . Non-corrosive stainless steel or polymer drain pan with 3/4" NPT drain connection.
- L . 20 gauge steel Coil casing with baked enamel finish and fiberglass insulation.
- M . This Contractor shall provide all temperature control and interlocking necessary to perform the specified control sequence. All wiring is to be in conduit in accordance with Division 26 - Electrical. All relays, transformers and controls are to be in enclosures.
- N . Provide a Honeywell RedLINK Wireless VisionPRO 8000 – TH8110R1008 thermostat with 2 occupied periods per day, automatic changeover, separate heating and cooling set points for both occupied and unoccupied modes. Provide auxiliary controls on sub-base to open minimum outside air damper during occupied mode. Substitutions will not be accepted.
- O . Provide lockable thermostat guards in public spaces.

- P . During occupied mode run the supply fan continuously, cycle the cooling or heating as required to maintain occupied space temperature cooling or heating set point. During unoccupied mode cycle the supply fan and cooling or heating as required to maintain unoccupied cooling or heating temperature set point.

PART 3 EXECUTION

3.1 INSTALLATION

- A . Install units as shown on plans and according to the manufacturer's installation instructions.
- B . Install remote thermostats where indicated on the drawings. Provide all wiring between remote thermostats and the gas fired item.

3.2 FURNACES

- A . Install on concrete housekeeping pad, steel stand or suspend unit from structure as indicated on the drawings. Pipe condensate to floor drain or as indicated on plans.
- B . Provide schedule 40 PVC, ASTM D1785 combustion air and vent piping and fittings with solvent welded joints as indicated on the drawings. Terminate as recommended by the furnace manufacturer.

3.3 OWNER TRAINING

- A . Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 8 hours.

END OF SECTION

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SECTION 236213

PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR AND CONDENSING UNITS

1.1 SCOPE

- A . This section includes specifications for air cooled condensing units for use with split system type air conditioning. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Reference.
 - d. Reference Standards.
 - e. Quality Assurance.
 - f. Submittals.
 - g. Operation and Maintenance Data.
 - h. Delivery, Storage and Handling.
 - i. Warranty.
 2. PART 2 – PRODUCTS.
 - a. Units up to 5 Tons.
 - b. Refrigerant Piping Sizing.
 - c. Refrigerant Piping Accessories.
 3. PART 3 – EXECUTION.
 - a. Installation.
 - b. Startup.

1.2 RELATED WORK

- A . Section 230500 - Common Work Results for HVAC.

1.3 REFERENCE

- A . Applicable provisions of Division 1 shall govern work under this section.

1.4 REFERENCE STANDARDS

- | | |
|-----------------|--|
| A . ARI 210/240 | Unitary Air Conditioning and Heat Pump Equipment. |
| B . ARI 365 | Commercial and Industrial Unitary Air Conditioning Condensing Units. |
| C . ASHRAE 15 | Safety Standard for Refrigeration Systems. |
| D . ASHRAE 90.1 | (2004 edition)Energy Standard for Buildings Except Low Rise Residential Buildings. |
| E . NEC | National Electrical Code. |
| F . ASTM B117 | Standard Practice for Operating Salt Spray (fog) Apparatus. |
| G . UL | Underwriters Laboratory. |

1.5 QUALITY ASSURANCE

- A . Unit Energy Efficiency Ratio (EER), Coefficient of Performance (COP) and Integrated Part Load Value (IPLV) shall meet the minimum applicable requirements of ASHRAE 90.1(2004 edition). Units that are labeled ENERGY STAR® will be acceptable.
- B . Rate unit performance in accordance with the latest edition of ARI Standard 365 or ARI Standard 210/240, whichever is applicable for the equipment.
- C . Construct units in accordance with ASHRAE 15, UL standards and the NEC. Units shall carry the UL label.

- D . Factory run test units to see that each control device operates properly. Pressure test, evacuate, charge with holding charge of refrigerant and full oil charge prior to shipping from the factory.

1.6 SUBMITTALS

- A . Submit shop drawings including the following information: specific manufacturer and model numbers, dimensional and weight data, required clearances, materials of construction, capacities and ratings, stages of unloading capacity achievable without hot gas bypass (and with hot gas bypass if applicable), refrigerant type and charge, component information, size and location of piping connections, electrical connections, wiring diagrams and information for all specialties and accessories.
- B . Submit manufacturer's installation and start-up instructions, maintenance data, troubleshooting guide, parts lists, controls and accessories.
- C . At substantial completion, submit warranty certificate and copy of start-up report.

1.7 OPERATION AND MAINTENANCE DATA

- A . All operations and maintenance data shall comply with the submission and content requirements specified.

1.8 DELIVERY, STORAGE AND HANDLING

- A . Comply with manufacturer's instructions for storing, rigging, unloading, and transporting units. Protect units from physical damage. Leave factory-shipping covers in place until installation.
- B . Ship units to jobsite fully assembled.

1.9 WARRANTY

- A . Provide a one-year parts and labor warranty on the entire unit beginning upon substantial completion of project.
- B . Provide a five-year parts warranty on the compressor(s) beginning upon substantial completion of project.

PART 2 PRODUCTS

2.1 UNITS UP TO 5 TONS

- A . Manufacturers:
 - 1. Lennox: www.lennox.com.
 - 2. Carrier: www.carrier.com.
 - 3. York: www.york.com.
- B . Provide factory assembled, outdoor mounted, air -cooled condensing unit suitable for on grade or rooftop installation. Include compressor, air cooled condenser, refrigerant, lubrication system, interconnecting wiring, safety and operating controls, motor starting components and additional features as specified herein or required for safe, automatic operation. Capacity and steps of unloading as indicated in the equipment schedule. Refrigerant is to be R-410A.
- C . CABINET:
 - 1. Construct cabinet of heavy gauge, galvanized steel coated with weather resistant paint. Provide removable access panels to facilitate full access to the compressor, fan and control components.
- D . COMPRESSOR:
 - 1. Provide hermetic reciprocating or scroll type compressor with built in motor winding temperature and current protection, liquid and suction service valves, gage ports, sight glass and liquid line filter dryer. Provide crankcase heater with reciprocating type compressors. Mount compressors on vibration isolators. Cooling shall be two-stage.

- E . CONDENSER:
 - 1. Provide condenser coils with aluminum alloy plate fins mechanically fastened to seamless copper tubing with integral subcooler. Construct coils with design working pressure suitable for the refrigerant. Louvered condenser guard shall be provided.
- F . Provide direct-drive statically and dynamically balanced propeller type fans with vertical or horizontal discharge as indicated on the drawings and guards constructed of heavy gage PVC coated wire or galvanized steel.
- G . POWER WIRING:
 - 1. Provide factory installed 24-volt control circuit with fusing; control power transformer and all associated internal wiring. Provide a single point power connection to the unit(s). Provide factory installed magnetic contactors for compressor and condenser motors.
 - 2. Electrical characteristics shall be as indicated in the equipment schedule.
- H . CONTROLS:
 - 1. Provide high/low refrigerant pressure cutouts with manual reset and anti-short cycle compressor timer.
 - 2. Provide "low ambient" controls and accessories needed so that unit is capable of operating down to ambient temperature of 25F.

2.2 REFRIGERANT PIPING SIZING

- A . The unit manufacturer shall verify the final refrigeration pipe sizing process to ensure conformance to specific unit requirements such as max lengths, refrigerant velocities, unloading considerations and proper oil return. Provide factory pre-charged line sets unless the distance between the unit and the evaporator coil is too great. In this case, provide sizing criteria and materials to the Mechanical Contractor for this purpose.

2.3 REFRIGERANT PIPING ACCESSORIES

- A . For systems using R-410A, provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 850 psig and a maximum working temperature of 225 degree F.
- B . Filter Dryers: For circuits below 15 tons provide straight pattern filter dryers without replaceable core.
- C . Sight glasses: Two piece brass construction with solder end connections. Include color indicator for sensing moisture.
- D . Solenoid Valves: Two way normally closed with two piece brass body, full port, stainless steel plug, stainless steel spring, teflon diaphragm and solder end connections. Provide replaceable coil assembly.
- E . Thermostatic Expansion Valves: Brass body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.
- F . Charging Valves: Provide ¼" SAE brass male flare access ports with finger tight, quick seal caps. Provide 2-inch long copper extension sections.
- G . Check valves: Spring loaded type with bronze body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

PART 3 EXECUTION

3.1 INSTALLATION

- A . Install units, piping and accessories in accordance with the manufacturer's written instructions and recommendations. Mount unit(s) on a poured concrete pad on grade or on roof mounted rails as indicated on the drawings. Units shall be level on pitched roofs.
- B . Maintain adequate service access and airflow clearances for all components as recommended by the manufacturer and as indicated on the drawings.

- C . Charge unit(s) with full oil charge and refrigerant charge based on the entire refrigeration system pipe size and length.
- D . Provide all control wiring in conduit in compliance Division 26 - Electrical.
- E . Coordinate power wiring requirements with the electrical trade.

3.2 STARTUP

- A . Adjust units for maximum operating efficiency, adjust all controls to required final settings and demonstrate that all components are functioning properly. Submit four copies of a written startup report following the initial start up. Include in the report: work done to the system, all readings taken, a statement certifying that the refrigeration system(s) are leak free and a statement certifying that the unit(s) have been placed in proper running condition as recommended by the manufacturer and as intended in the drawings and specifications.

END OF SECTION

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The electrical work included in all other Divisions is the responsibility of the Contractor performing the Division 26 work unless noted otherwise.

1.2 SCOPE

- A. The work under this section includes basic electrical requirements, which are applicable to all Division 26 sections. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:
 - 1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Reference Standards.
 - d. Regulatory Requirements.
 - e. Quality Assurance.
 - f. Continuity of Existing Services and Systems.
 - g. Protection of Finished Surfaces.
 - h. Approved Electrical Testing Laboratories.
 - i. Sleeves and Openings.
 - j. Sealing and Firestopping.
 - k. Intent.
 - l. Omissions.
 - m. Submittals.
 - n. Project/Site Conditions.
 - o. Work Sequence and Scheduling.
 - p. Work by Other Trades.
 - q. Offsite Storage.
 - r. Request and Certificate for Payment.
 - s. Salvage Materials.
 - t. Certificates and Inspections.
 - u. Operating and Maintenance Data.
 - v. Record Drawings.
 - 2. PART 2 – PRODUCTS.
 - a. Access Panels and Doors.
 - b. Identification.
 - c. Sealing and Firestopping.
 - 3. PART 3 – EXECUTION.
 - a. Excavation and Backfill.
 - b. Concrete Work.
 - c. Cutting and Patching.
 - d. Building Access.
 - e. Equipment Access.
 - f. Coordination.
 - g. Sleeves.
 - h. Sealing and Firestopping.
 - i. Housekeeping and Clean Up.
 - j. Owner Training.

1.3 RELATED WORK

- A. Applicable provisions of Bidding requirements and Division 1 – General Requirements govern work under this Section.

1.4 REFERENCE STANDARDS

- A. Abbreviations of standards organizations referenced in this and other sections are as follows:
 - 1. ANSI American National Standards Institute.
 - 2. ASTM American Society for Testing and Materials.
 - 3. EPA Environmental Protection Agency.
 - 4. ETL Electrical Testing Laboratories, Inc.
 - 5. IEEE Institute of Electrical and Electronics Engineers.
 - 6. IES Illuminating Engineering Society.
 - 7. ISA Instrument Society of America.
 - 8. NBS National Bureau of Standards.
 - 9. NEC National Electric Code.
 - 10. NEMA National Electrical Manufacturers Association.
 - 11. NESC National Electrical Safety Code.
 - 12. NFPA National Fire Protection Association.
 - 13. UL Underwriters Laboratories Inc.

1.5 REGULATORY REQUIREMENTS

- A. All work and materials are to conform in every detail to applicable rules and requirements of the State of Oklahoma Electrical Code the National Electrical Code (ANSI/NFPA 70), other applicable National Fire Protection Association codes, the National Electrical Safety Code, and present manufacturing standards (including NEMA).
- B. All Division 26 work shall be done under the direction of a currently certified State of Oklahoma Certified Master Electrician.

1.6 QUALITY ASSURANCE

- A. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space and for obtaining the performance from the system into which these items are placed.
- B. Manufacturer references used herein are intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply. Where two or more manufacturers are specified and no reference is made to “or equal” other manufacturers, other manufacturers will be considered. Written notification of intent to use manufacturers other than those specified is required ten days prior to bid. Submittals shall be reviewed only after bidding and may be rejected if any aspect of the equivalent product is deemed lesser than that of the specified product by the specifier. The contractor shall be responsible for ensuring alternates are equivalent to those specified.
- C. All materials, except medium voltage equipment and components, shall be listed by and shall bear the label of an approved electrical testing laboratory. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable, and approved by Owner, shall apply and such items shall bear those labels. Where one of the approved electrical testing laboratories has an applicable system listing and label, the entire system, except for medium voltage equipment and components, shall be so labeled.

1.7 CONTINUITY OF EXISTING SERVICES AND SYSTEMS

- A. No outages shall be permitted on existing systems except at the time and during the interval specified by the Owner Project Representative. The Owner may require written approval. Any outage must be scheduled when the interruption causes the least interference with normal schedules and business routines. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.
- B. This Contractor shall restore any circuit interrupted as a result of this work to proper operation as soon as possible. Note that Owner operations are on a seven-day week schedule, unless otherwise specified.

1.8 PROTECTION OF FINISHED SURFACES

- A. Furnish one can of touch-up paint for each different color factory finish furnished by the Contractor. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

1.9 APPROVED ELECTRICAL TESTING LABORATORIES

- A. The following laboratories are approved for providing electrical product safety testing and listing services as required in these specifications:
 - 1. Underwriters Laboratories Inc.
 - 2. Electrical Testing Laboratories, Inc.

1.10 SLEEVES AND OPENINGS

- A. Below Grade Wall Penetrations.
- B. Conduit Penetrations.

1.11 SEALING AND FIRESTOPPING

- A. Sealing and firestopping of sleeves/openings between conduits, cable trays, wireways, troughs, cablebus, busduct, etc. and the structural or partition opening shall be the responsibility of the Contractor whose work penetrates the opening. The Contractor responsible shall hire individuals skilled in such work to do the sealing and firestopping. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.12 INTENT

- A. The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical equipment and systems installation herein specified, except such parts as are specifically exempted herein.
- B. If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the Drawings, the Contractor shall furnish the item, system, or workmanship, which is the highest quality, largest, or most closely fits the Owner's intent (as determined by the Owner / Project Manager). Refer to the General Conditions of the Contract for further clarification.
- C. It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.
- D. All sizes as given are minimum except as noted.
- E. Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject at all times to the Owner's and/or Architect/Engineer's inspections, tests and approval from the commencement until the acceptance of the completed work.
- F. Whenever a particular manufacturer's product is named, it is intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

1.13 OMISSIONS

- A. No later than ten (10) days before bid opening, the Contractor shall call the attention of the Owner to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

1.14 SUBMITTALS

- A. Refer to applicable sections in Bidding Requirements and Division 1 – General Requirements.
- B. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.
- C. On request from the Owner or Architect/Engineer, the successful bidder shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.
- D. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.
- E. The submittals must be approved before fabrication is authorized.

1.15 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner before proceeding.
- C. Tools, materials and equipment shall be confined to areas designated by the Owner.

1.16 WORK SEQUENCE AND SCHEDULING

- A. Install work in phases to accommodate Owner's occupancy requirements. During the construction period coordinate electrical schedule and operations with Owner's Construction Representatives.

1.17 WORK BY OTHER TRADES

- A. Every attempt has been made to indicate in this trade's specifications and drawings all work required of this Contractor. However, there may be additional specific paragraphs in other trade specifications and addenda, and additional notes on drawings for other trades which pertain to this Trade's work, and thus those additional requirements are hereby made a part of these specifications and drawings.
- B. Electrical details on drawings for equipment to be provided by others are based on preliminary design data only. This Contractor shall lay out the electrical work and shall be responsible for its correctness to match equipment actually provided by others.

1.18 OFFSITE STORAGE

- A. If payment will be requested for approved offsite stored material, then the Contractor shall complete an "Off-site Storage Agreement" which the Owner will consider on a case by case basis. Prior approval by Owner personnel for offsite storage will be needed. No material will be accepted for offsite storage unless submittals for the material have been approved.

1.19 REQUEST AND CERTIFICATE FOR PAYMENT

- A. Refer to the General Conditions of the Contract for all payment request requirements. A cost breakdown of the proposed values for work performed which may be required by the Owner and if approved by the Owner, will become the basis for construction progress and monthly payments. The cost breakdown items shall reflect actual work progress stages as closely as feasible.

1.20 SALVAGE MATERIALS

- A. No materials removed from this project shall be reused. All materials removed shall become the property of and shall be disposed of by the Contractor.

1.21 CERTIFICATES AND INSPECTIONS

- A. Refer to the General Conditions for Certificates and Inspections.
- B. This Contractor is responsible for coordination of Owner electrical inspection. Inspection requirements will be issued at a pre-installation meeting, arranged by this Contractor and the Electrical Inspector having jurisdiction.

1.22 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. In addition to the general content specified under applicable sections in Bidding Requirements and Division 1 - General Requirements supply the following additional documentation:
 - 1. Manufacturer's wiring diagrams for electrically powered equipment.

1.23 RECORD DRAWINGS

- A. The Contractor shall maintain at least one copy each of the specifications and drawings on the job site at all times.
- B. The Owner or Engineer will provide the Contractor with a suitable set of contract drawings on which daily records of changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall locate all buried or concealed piping, conduit, or similar items.
- C. The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will be permitted.
- D. At completion of the project, the Contractor shall submit the marked-up record drawings to the Owner prior to final payment.

PART 2 PRODUCTS

2.1 ACCESS PANELS AND DOORS

- A. Lay-in Ceilings:
 - 1. Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration provided under other divisions are sufficient; no additional access provisions are required unless specifically indicated.
- B. Concealed Spline Ceilings:
 - 1. Removable sections of ceiling tile held in position with metal slats or tabs compatible with the ceiling system used will be provided under other divisions.
- C. Metal Pan Ceilings:
 - 1. Removable sections of ceiling tile held in position by pressure fit will be provided under other divisions.
- D. Plaster Walls and Ceilings:

1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers and similar wet areas, concealed hinges, screwdriver operated cam latch for general application, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

2.2 IDENTIFICATION

- A. See Electrical Section 260553 – Identification for Electrical Systems.

2.3 SEALING AND FIRESTOPPING

- A. Fire and/or Smoke Rated Penetrations:
 1. Whenever possible, avoid penetrations of fire and smoke rated partitions. When they cannot be avoided, verify that sufficient space is available for the penetration to be effectively fire and smoke stopped.
- B. Manufacturers:
 1. 3M: www.3m.com.
 2. STI/SpecSeal: www.stifirestop.com.
 3. Tremco: www.tremcosealants.com.
 4. Hilti: www.hilti.com.
- C. All firestopping systems shall be by the same manufacturer.
- D. Submittals:
 1. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
 2. Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.
- E. Product:
 1. Firestop systems shall be UL listed or tested by an independent testing laboratory approved by the Department of Commerce.
- F. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
- G. Contractor shall use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.
- H. Non-Rated Penetrations:
 1. Conduit Penetrations Through Below Grade Walls:
 - a. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated conduit and the cored opening or a water-stop type wall sleeve.
 2. Conduit and Cable Tray Penetrations:
 - a. At conduit and cable tray penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between conduit and sleeve, or the core drilled opening.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

- A. Perform all excavation and backfill work to accomplish indicated electrical systems installation in accordance with Division 31 - Trenching. Blasting will not be allowed without written permission of the Owner.

3.2 CONCRETE WORK

- A. The Division 3 Contractor will perform all cast-in-place concrete unless noted otherwise elsewhere. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for the support of electrical equipment.

3.3 CUTTING AND PATCHING

- 1. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.

3.4 BUILDING ACCESS

- A. Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this Contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.5 EQUIPMENT ACCESS

- A. Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, furnish the access doors to the General Contractor and reimburse the General Contractor for installation of those access doors.

3.6 COORDINATION

- A. The Contractor shall cooperate with other trades and Owner's personnel in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.
- B. The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to light fixtures, panelboards, devices, etc. and recessed or semi-recessed heating units installed in/on architectural surfaces.
- C. Coordinate all work with other Contractors prior to installation. Any installed work that is not coordinated and that interferes with other Contractor's work shall be removed or relocated at the installing Contractor's expense.
- D. Cooperate with the testing consultant in ensuring specification Section 260504 compliance. Verify system completion to the testing consultant. Demonstrate the starting, interlocking and control features of each system so the testing Contractor can perform its work.

3.7 SLEEVES

- A. Pipe sleeves for conduits 6" in diameter and smaller, in new poured concrete construction, shall be schedule 40 steel pipe, plastic removable sleeve or sheet metal sleeve, all cast in place.
- B. In wet area floor penetrations, top of sleeve to be 2 inches above the adjacent floor. In existing wet area floor penetrations, core drill sleeve openings large enough to insert schedule 40 sleeve and grout the area around the sleeve. If a pipe clamp resting on the sleeve supports the pipe penetrating the sleeve, weld a collar or struts to the sleeve that will transfer weight to the existing floor structure. Wet areas for this paragraph are rooms or spaces containing air handling unit coils, converters, pumps, chillers, boilers, and similar waterside equipment.

- C. Pipe penetrations in existing concrete floors that are not in wet areas may omit the use of schedule 40 sleeve and use the core drilled opening as the sleeve.

3.8 SEALING AND FIRESTOPPING

- A. Fire and/or Smoke Penetrations:
 - 1. Install approved product in accordance with the manufacturer's instructions where a pipe (i.e. cable tray, bus, cable bus, conduit, wireway, trough, etc.) penetrates a fire rated surface.
- B. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.
- C. Non-Rated Surfaces:
 - 1. When the opening is through a non-fire rated wall, floor, ceiling or roof the opening must be sealed using an approved type of material.
 - 2. Install escutcheons or floor/ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces for this paragraph include only those rooms with finished ceilings and the penetration occurs below the ceiling.
 - 3. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the conduit and tighten in place, in accordance with the manufacturer's instructions. Install so that the bolts used to tighten the seal are accessible from the interior of the building or vault.
 - 4. At interior partitions, conduit penetrations are required to be sealed for all clean rooms, laboratories, and most hospital spaces, computer rooms, dormitory rooms, tele/data/com rooms and similar spaces where the room pressure or odor transmission must be controlled. Apply sealant to both sides of the penetration in such a manner that the annular space between the conduit sleeve and the conduit is completely filled.

3.9 HOUSEKEEPING AND CLEAN UP

- A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

END OF SECTION

SECTION 260504

CLEANING, INSPECTION, AND TESTING OF ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 SCOPE

- A. The work under this section includes the required cleaning, repair, adjustment, calibration, maintenance and testing of electrical equipment, as specified herein. This applies only to new electrical and existing electrical equipment being furnished, modified, worked on or serviced by this Contractor for this project. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 2. PART 2 – PRODUCTS.
 - a. Not Used.
 3. PART 3 – EXECUTION.
 - a. General Inspection and Cleaning of all Equipment.
 - b. Grounding Systems.
 - c. Mechanical and Electrical Interlock System.
 - d. Dry Type Transformers.
 - e. Cables.
 - f. Panelboards.
 - g. Light Fixtures.
 - h. Occupancy Sensors.
 - i. Battery Pack Emergency Lighting.

1.2 RELATED WORK

- A. Applicable provisions of Division 1 govern work under this Section.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 GENERAL INSPECTION AND CLEANING OF ALL ELECTRICAL EQUIPMENT

- A. Inspect for physical damage and abnormal mechanical and electrical conditions.
- B. Any item found to be out of tolerance, or in any other way defective as a result of the required testing, shall be reported to the Engineer and Owner. Procedure for repair and/or replacement will be outlined. After appropriate corrective action is completed the item shall be re-tested.
- C. Compare equipment nameplate information with the latest single line diagram and report any discrepancies.
- D. Verify proper auxiliary device operation and indicators.
- E. Check tightness of accessible bolted electrical joints. Use torque wrench method.
- F. Make a close examination of equipment and remove any shipping brackets, insulation, packing, etc. that may not have been removed during original installation.
- G. Make a close examination of equipment and remove any dirt or other forms of debris that may have collected in existing equipment or in new equipment during installation.
- H. Clean All Equipment:
 1. Vacuum inside of panelboards, switchboards, switchgear, transformer core and coils, horizontal and vertical busducts, MCC's, fire alarm panels, comm/data, security panel, etc.
 2. Loosen attached particles and vacuum them away.
 3. Wipe all insulators with a clean, dry, lint free rag.
 4. Clean insulator grooves.

- 5. Re-vacuum inside surfaces as directed by the Owner's Construction Representative or Inspector.
- I. Inspect equipment anchorage.
- J. Inspect equipment and bus alignment.
- K. Check all heater elements for operation and control.
- L. Lubricate nonelectrical equipment per manufacturer's recommendations.

3.2 GROUNDING SYSTEMS

- A. Inspect the ground system for adequate termination at all devices.

3.3 MECHANICAL AND ELECTRICAL INTERLOCK SYSTEM

- A. Physically test each system to ensure proper function, operation and sequencing.
- B. Closure attempt shall be made on locked open devices.
- C. Opening attempt shall be made on locked closed devices.
- D. Key exchange shall be made with devices operated in off normal positions.

3.4 DRY TYPE TRANSFORMERS

- A. Test and adjust the cooling fans, controls and alarm functions.
- B. Measure secondary voltage phase-to-phase and phase-to-ground after final energization and prior to loading.
- C. Verify and/or connect transformer "XO" to ground, load side of "WYE" systems.

3.5 CABLES

- A. Visual and Mechanical Inspections:
 - 1. Inspect exposed sections for physical damage.
 - 2. Verify cable is supplied and connected in accordance with single line diagram.
 - 3. Inspect for shield grounding, cable support and termination.
 - 4. If cables are terminated through window type C.T.'s make an inspection to verify that neutrals and grounds are properly terminated for normal operation of protective devices.
 - 5. Inspect for visual jacket and insulation condition.
 - 6. Visible cable bends shall be checked against ICEA or manufacturer's minimum allowable bending radii -- 12 times the diameter for tape shielded cables.
 - 7. Inspect for proper fireproofing in common cable areas.
 - 8. There shall be NO tests performed on existing cable without specific direction from the Consulting Engineer.
- B. Electrical Tests -- Below 600 Volts:
 - 1. All secondary cables from the substation transformers to the secondary switchboards shall be subjected to insulation tests using a 500 vdc megger.
 - 2. Visually inspect cables, lugs, connectors and all other components for physical damage and proper connections.
 - 3. Check all cable connectors for tightness (with a torque wrench) and clearances. Torque test conductor and bus terminations to manufacturer's recommendations.
 - 4. Check for proper grounding resistance at all services and at transformers. Resistance shall be 2 ohms maximum.
 - a. Above 600 volts:
 - 1) Above 600 volt testing will be performed under a separate contract.

3.6 PANELBOARDS

- A. Torque all the connections per the manufacturers spec. Verify phase wires, color coding, separate neutral and mechanical bonding. Verify circuit breaker operation. Verify the directory.

3.7 LIGHT FIXTURES

- A. Check the bonding and proper lamping. Verify that recessed fixtures are installed with hold down clips. Confirm operation of the fixture with the proper switch or sensor.

3.8 OCCUPANCY SENSORS

- A. Confirm operation of the sensor per the manufacturers spec.

3.9 BATTERY PACK EMERGENCY LIGHTING

- A. Verify the operation per the manufacturers spec and run all of the diagnostic steps. Confirm proper grounding and location.

END OF SECTION

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SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SCOPE

- A. The work under this section includes furnishing and installing required wiring and cabling systems including pulling, terminating and splicing. Included are the following topics:
 - 1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. References.
 - d. Submittals.
 - e. Project Conditions.
 - 2. PART 2 – PRODUCTS.
 - a. General.
 - b. Building Wire.
 - c. Underground Wire for Exterior Work.
 - d. Wiring Connectors.
 - 3. PART 3 – EXECUTION.
 - a. General Wiring Methods.
 - b. Wiring Installation In Raceways.
 - c. Wiring Connections and Terminations.
 - d. Field Quality Control.
 - e. Wire Color.
 - f. Branch Circuits.
 - g. Emergency Circuits.

1.2 RELATED WORK

- A. Applicable provisions of Bidding Requirements and Division 1 - General Requirements govern work under this section.
- B. Section 260533 – Raceway and Boxes for Electrical Systems.
- C. Section 260553 – Identification for Electrical Systems.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Refer to applicable sections of Bidding Requirements and Division 1 - General Requirements.
- B. Submit product data: Provide for each cable assembly type.
- C. Submit factory test reports: Indicate procedures and values obtained.
- D. Submit shop drawings for modular wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.
- E. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.5 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.

- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 PRODUCTS

2.1 GENERAL

- A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.
- B. All conductors shall be copper.
- C. Insulation shall have a 600 volt rating.
- D. All conductors shall be stranded.
 - 1. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.

2.2 BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Insulation: Type THHN/THWN, XHHW-2 insulation for feeders and branch circuits.

2.3 UNDERGROUND WIRE FOR EXTERIOR WORK

- A. Description: Stranded single or multiple conductor insulated wire.
- B. Insulation: Type XHHW-2 or USE.
- C. This wiring shall be used in all underground applications, except when run in a concrete-encased ductbank.

2.4 WIRING CONNECTORS

- A. Split Bolt Connectors: Not acceptable.
- B. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.
- C. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
- D. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.
- E. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.
- F. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps. Connector shall be irreversible type meeting IEEE Standard 837-2002, UL Listed.

PART 3 EXECUTION

3.1 GENERAL WIRING METHODS

- A. All wire and cable shall be installed in conduit.
- B. Do not use wire smaller than 12 AWG for power and lighting circuits.

- C. All conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity. As a minimum use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m), and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).
- D. Make conductor lengths for parallel conductors equal.
- E. Splice only in junction or outlet boxes.
- F. No conductor less than 10 AWG shall be installed in exterior underground conduit.
- G. Identify ALL low voltage, 600v and lower, wire per section 260553.
- H. Neatly train and lace wiring inside boxes, equipment, and panelboards.

3.2 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor) in the same raceway. If parallel phase and/or neutral wires are used, then place an equal number of phase and neutral conductors in same raceway or cable.
- E. VFD Installations: Install VFD input wiring and output wiring in separate conduit systems. Do not mix VFD input power and output power, or control wiring in a common raceway.

3.3 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible junction boxes.
- B. Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without soldering and without perceptible temperature rise.
- C. All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.
- D. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.
- E. Use mechanical or compression connectors for wire splices and taps, 8 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
- F. Thoroughly clean wires before installing lugs and connectors.
- G. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

3.4 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 260504.
 1. Additional testing as follows shall be performed if aluminum conductors are used:
 - a. Equipment terminated with aluminum conductors shall be tested with a thermal imager and recorded.
 - b. Conductors shall be closely checked for loose or poor connections, and for signs of overheating or corrosion.
 - c. Test procedures shall meet NETA guidelines.
 - d. Test results and report shall be provided to the engineer.
 - e. Contractor shall correct all deficiencies reported in the test report.

3.5 WIRE COLOR

- A. General:
 - 1. For wire sizes 10 AWG and smaller - Wire shall be colored as indicated below.
 - 2. For wire sizes 8 AWG and larger – Use colored wire, or identify wire with colored tape at all terminals, splices and boxes. Colors to be as indicated below.
 - 3. In existing facilities, use existing color scheme.
 - 4. In new facilities, use black and red for single phase circuits at 120/240 volts, use Phase A black, Phase B red and Phase C blue for circuits at 120/208 volts single or three phase, and use Phase A brown, Phase B orange and Phase C yellow for circuits at 277/480 volts single or three phase. Note: This includes fixture whips except for Listed whips mounted by the fixture manufacturer on the fixture and Listed as a System.
 - 5. All switch legs shall be the same color as their associated circuit. Traveler conductors run between 3 and 4 way switches shall be colored pink or purple.
- B. Neutral Conductors: White for 120/208V and 120/240V systems, Gray for 277/480V systems. Where there are two or more neutrals in one conduit, each shall be individually identified with a different stripe.
- C. Branch Circuit Conductors: Three or four wire home runs shall have each phase uniquely color coded.
- D. Feeder Circuit Conductors: Each phase shall be uniquely color coded.
- E. Ground Conductors: Green for 6 AWG and smaller. For 4 AWG and larger, identify with green colored wire, or with green tape at both ends and at all access points, such as panelboards, motor starters, disconnects and junction boxes. When isolated grounds are required, Contractor shall provide green with yellow tracer.

3.6 BRANCH CIRCUITS

- A. The use of single-phase, multi-wire branch circuits with a common neutral is not permitted. All branch circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the phase conductors.

3.7 EMERGENCY CIRCUITS

- A. All emergency system wiring (level 1 and level 2) shall be installed in separate raceways after their associated transfer switches. The wiring shall be separate from each other and from all normal system wiring.

END OF SECTION

SECTION 260523

CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 GENERAL

1.1 SCOPE

- A. The work under this section includes furnishing and installing required remote control and signal cabling. Included are the following topics:
 - 1. PART 1 - GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. References.
 - d. Submittals.
 - e. Project Conditions.
 - 2. PART 2 - PRODUCTS.
 - a. General.
 - b. Remote Control and Signal Cable.
 - c. Wiring Connectors.
 - 3. PART 3 - EXECUTION.
 - a. General Wiring Methods.
 - b. Wiring Installation In Raceways.
 - c. Free-Air Cable Installation.
 - d. Wiring Connections and Terminations.
 - e. Field Quality Control.

1.2 RELATED WORK

- A. Applicable provisions of Division 1 govern work under this Section.
- B. Section 260533 - Raceway and Boxes for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements, for submittal procedures.
- B. Submit product data: Provide for each cable assembly type.
- C. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.5 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 PRODUCTS

2.1 GENERAL

- A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.
- B. All conductors shall be copper.
- C. Insulation shall have a 600 volt rating.
- D. All conductors must be suitable for the application intended. Conductors #12 and smaller may be solid or stranded with the following requirements or exceptions:
 - 1. All conductors terminated with crimp type devices must be stranded.
 - 2. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.

2.2 REMOTE CONTROL AND SIGNAL CABLE

- A. Refer to Section 283100 for requirements for cable to be used on fire alarm systems.
- B. Refer to Drawings for requirements for cable to be used on communication systems.
- C. All other systems cabling shall meet the requirements of NEC Article 725 and the following:
 - 1. Control Cable for Class 1 Remote Control and Signal Circuits: 600 volt insulation, individual conductors twisted together, shielded, and covered with an overall PVC jacket. Cable shall be Listed, temperature rated, and plenum or non-plenum rated for the application as required in the National Electrical Code.
 - 2. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits shall be constructed, Listed, temperature rated, and plenum or non-plenum rated for the application as required in the NEC Article 725.

2.3 WIRING CONNECTORS

- A. Split Bolt Connectors: Not acceptable.
- B. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
- C. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.

PART 3 EXECUTION

3.1 GENERAL WIRING METHODS

- A. Low voltage control and signal cables shall be installed in conduit. However, they may be installed without conduit above accessible ceilings if the cable meets NEC requirements for the application, unless specified to be in conduit in other sections of the specifications. See requirements for free-air cabling installation below.
- B. Control cables for controlling HVAC and lighting equipment connected to emergency power shall be routed in raceway.
- C. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts, all sizes subject to NEC 725 requirements.
- D. Splice only in junction boxes.
- E. Identify wire per section 260553.
- F. Neatly train and lace wiring inside boxes, and equipment.

3.2 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling conditions when necessary.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.

3.3 FREE-AIR CABLE INSTALLATION

- A. When permitted in exposed ceiling areas, 'Free-Air' wiring runs shall avoid areas of high traffic (i.e. aisle way), shall be run as close as possible to outlining walls and shall be a minimum of ten (10) feet above finished floor.
- B. Cabling shall be neatly run at right angles and be kept clear of other trades work.
- C. Cabling shall be supported at a maximum of 4-foot intervals utilizing 'bridal-type' mounting rings anchored to ceiling concrete, piping supports or structural steel beams. If cable sag at mid-span exceeds 12-inches, another support shall be provided. Mounting rings shall be designed to maintain cables bend to larger than the minimum bed radius (typically 4 x cable diameter).
- D. Cabling shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, suspended ceiling supports or electrical conduit. Additionally, cabling shall not be laid directly on the ceiling grid.
- E. To reduce or eliminate Electro-Magnetic Interference (EMI), the following minimum separation distances for 'Free-Air' cabling installations shall be adhered to:
 - 1. Twelve (12) inches from power lines of less than 5kV.
 - 2. Thirty-nine (39) inches from power lines of 5kV or greater.
 - 3. Eighteen (18) inches from lighting fixtures.
 - 4. Thirty-nine (39) inches from transformers and motors.
- F. A coil of 2 feet in each cable shall be placed in the ceiling at each 'free-air' wired device. These coils shall be secured (wire tied) at the last cable support before the cable reaches the device and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.
- G. All cable shall be free of tension at both ends. Nylon strain relief connectors shall be provided at each device and junction box where cables enter. In cases where the cable must bear some stress, Kellum type grips may be used to spread the strain over a longer length of cable.
- H. Cable manufacturers minimum bend radius shall be observed in all instances. Care should be taken in the use of cable ties to secure and anchor the station cabling. Ties should not be over tightened as to compress the cable jacket. No sharp burrs should remain where excess length of the cable tie has been cut.
- I. All exposed vertical cable extensions to devices located below the finished ceiling shall be in conduit.
- J. Provide protection for exposed cables where subject to damage.
- K. Use suitable cable fittings and connectors.

3.4 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible junction boxes.
- B. All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.
- C. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.
- D. Thoroughly clean wires before installing lugs and connectors.

- E. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 260504.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SCOPE

- A. The work under this section includes grounding electrodes and conductors, equipment grounding conductors, and bonding. Included are the following topics:
 - 1. PART 1 - GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. References.
 - d. Performance Requirements.
 - e. Submittals.
 - f. Project Record Documents.
 - g. Regulatory Requirements.
 - 2. PART 2 - PRODUCTS.
 - a. Rod Electrode.
 - b. Mechanical Connectors.
 - c. Compression Connectors.
 - d. Exothermic Connections.
 - e. Wire.
 - f. Bus.
 - 3. PART 3 - EXECUTION.
 - a. Examination.
 - b. General.
 - c. Less Than 600 Volt System Grounding.
 - d. Field Quality Control.

1.2 RELATED WORK

- A. Applicable provisions of Bidding Requirements and Division 1 - General Requirements govern work under this Section.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. ANSI/IEEE 142 (Latest edition) - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 2 ohms maximum at building service entrance.
- B. Testing of grounding system resistance is to be witnessed by the Engineer / Owner Representative. Provide test report of grounding system resistance in final O&M manuals.

1.5 SUBMITTALS

- A. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Product Data: Provide data for grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- D. Manufacturer's Instructions: Include instructions for preparation, installation and examination of exothermic connectors.

1.6 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of grounding electrodes.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 ROD ELECTRODE

- A. Material: Copper-clad steel.
- B. Diameter: 3/4 inch (19 mm) minimum.
- C. Length: 10 feet (3.5 m) minimum. Rod shall be driven at least 9' 6" deep.

2.2 MECHANICAL CONNECTORS

- A. The mechanical connector bodies shall be manufactured from high strength; high conductivity cast copper alloy material. Bolts, nuts, washers and lock washers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.
- B. Split bolt connector types are NOT allowed. Exception: The use of split bolts is acceptable for grounding of wire-basket type cable tray, and for cable shields/straps of medium voltage cable.
- C. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

2.3 COMPRESSION CONNECTORS

- A. The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99% by IACS standards.
- B. The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.
- C. The installation of the connectors shall be made with a compression, tool and die system, as recommended by the manufacturer of the connectors.
- D. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.
- E. Each connector shall be factory filled with an oxide-inhibiting compound.

2.4 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Cadweld: www.Cadweld.com.

2.5 WIRE

- A. Material: Stranded copper (aluminum not permitted).
- B. Grounding Electrode Conductor: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger.
- C. Foundation Electrodes: As shown on drawings.
- D. Primary Manhole, Main Switchgear room and Vault Bonding: No. 4/0 minimum.
- E. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used on the same facility.

2.6 BUS

- A. Material: Copper (aluminum not permitted).
- B. Size: 1/4" X 2" minimum.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 GENERAL

- A. Install Products in accordance with manufacturer's instructions.
- B. Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.
- C. Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.
- D. Attach grounds permanently before permanent building service is energized.
- E. All grounding electrode conductors shall be installed in PVC conduit, in exposed locations.

3.3 LESS THAN 600 VOLT SYSTEM GROUNDING

- A. Supplementary Grounding Electrode: Use driven ground rod on exterior of building or effectively grounded metal frame of the building.
- B. Provide code sized copper grounding electrode conductor from secondary switchboard ground bus, each separately derived system neutral, secondary service system neutral to street side of water meter, building steel, ground rod, and any concrete encased electrodes. Provide bonding jumper around water meter.
- C. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.
- D. Install ground grid under access floors where indicated. Construct grid of #4 AWG bare copper wire installed on 72 inch centers both ways. Bond each access floor support pedestal to grid.
- E. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to under floor ground grid. Use #4 AWG bare copper conductor.
- F. Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the respective enclosure.
- G. Provide communications system grounding conductor at point of service entrance and connect to building common grounding electrode system.
- H. Telecommunications and Audio Visual systems shall be installed with an isolated grounding system which has only one ground point. That ground point is to be the common grounding electrode system at the electrical service entrance for the building. Contractor is to provide an isolated grounding conductor from the electrical service entrance of the building to each Telecommunications Grounding Bus Bar (TGBB) in each Telecommunication Room. Use a minimum No. 2/0 AWG copper conductor, or as indicated on the plans, for the telecommunications service grounding conductor. Leave 10 feet slack grounding conductor at each Telecommunications Room. The grounding conductor MUST NOT be attached to building steel (except as allowed at the main electrical service entrance).
- I. Telecommunications Equipment Rack Grounding: Use a #6 or larger AWG copper conductor from all telecommunications cabinets and racks to the Telecommunications Grounding Bus Bar (TGBB) in each Telecommunication Room.

3.4 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

END OF SECTION

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SCOPE

- A. The work under this section includes conduit and equipment supports, straps, clamps, steel channel, etc, and fastening hardware for supporting electrical work. Included are the following topics:
 - 1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Submittals.
 - d. Quality Assurance.
 - 2. PART 2 – PRODUCTS.
 - a. Material.
 - 3. PART 3 – EXECUTION.
 - a. Installation.

1.2 RELATED WORK

- A. Applicable provisions of Bidding Requirements and Division 1 - General Requirements govern work under this section.

1.3 SUBMITTALS

- A. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Product Data: Provide data for support channel.

1.4 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Support Channel: Steel, Galvanized, Enameled or other corrosion resistant.
- B. Hardware: Corrosion resistant.
- C. Minimum sized threaded rod for supports shall be 3/8" for trapezes and single conduits 1-1/4" and larger, and 1/4" for single conduits 1" and smaller.
- D. Conduit clamps, straps, supports, etc., shall be steel or malleable iron. One-hole straps shall be heavy duty type. All straps shall have steel or malleable backing plates when rigid steel conduit is installed on the interior or exterior surface of any exterior building wall.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using pre-cast insert system, preset inserts, beam clamps, expansion anchors, or spring steel clips (interior metal stud walls only).
- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction. If nail-in anchors are used, they must be removable type anchors.

- C. **Powder-actuated fasteners and plastic wall anchors are not permitted.**
- D. File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not fasten to suspended ceiling grid system.
- F. Do not drill structural steel members unless approved by Owner.
- G. Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. In wet locations, mechanical rooms and electrical rooms install free-standing electrical equipment on 3.5 inch concrete pads.
- I. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall (7/8" Uni-strut or 3/4" painted, fire-retardant plywood is acceptable).
- J. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- K. Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

END OF SECTION

SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SCOPE

- A. The work under this section includes conduits, surface raceways, multi-outlet assemblies, auxiliary gutters, wall duct, and boxes for electrical systems including wall and ceiling outlet boxes, floor boxes, and junction boxes. Included are the following topics:
 - 1. PART 1 - GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Submittals.
 - 2. PART 2 - PRODUCTS.
 - a. Rigid Metal Conduit and Fittings.
 - b. PVC Coated Rigid Metal Conduit.
 - c. Intermediate Metal Conduit (IMC) and Fittings.
 - d. Electrical Metallic Tubing (EMT) and Fittings.
 - e. Flexible Metal Conduit and Fittings.
 - f. Liquidtight Flexible Metal Conduit and Fittings.
 - g. Rigid Nonmetallic Conduit and Fittings
 - h. Conduit Supports.
 - i. Auxiliary Gutters (Wireways).
 - j. Outlet Boxes.
 - k. Floor Boxes.
 - l. Pull and Junction Boxes.
 - m. General.
 - 3. PART 3 - EXECUTION.
 - a. Conduit Sizing, Arrangement and Support.
 - b. Conduit Installation.
 - c. Conduit Installation Schedule.
 - d. Coordination of Box Locations.
 - e. Outlet Box Installation.
 - f. Floor Box Installation.
 - g. Pull and Junction Box Installation.

1.2 RELATED WORK

- A. Applicable provisions of Bidding Requirements and Division 1 - General Requirements govern work under this section.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 262726 - Wiring Devices.
- D. Section 262702 - Equipment Wiring Systems.
- E. Division 27, for Communications Cable and Equipment.

1.3 SUBMITTALS

- A. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Surface Raceway System - submit product data and catalog sheets for all components.
- C. Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2 PRODUCTS

2.1 RIGID METAL CONDUIT AND FITTINGS

- A. Conduit: Heavy wall, galvanized steel, schedule 40, threaded.
- B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.2 PVC COATED RIGID METAL CONDUIT

- A. PVC Externally Coated Conduit: Rigid heavy wall, schedule 40, steel conduit with external 40 mil PVC coating. Conduit must be hot dipped galvanized inside and out including threads. The PVC coating bond to the galvanized steel conduit shall be stronger than the tensile strength of the coating itself.
- B. Fittings and Conduit Bodies: Threaded type, material to match conduit. PVC coated fittings and couplings shall have specially formed sleeves to tightly seal to conduit PVC coating. The sleeves shall extend beyond the fitting or coupling a distance equal to the pipe outside steel diameter or two inches whichever is greater.

2.3 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. Conduit: Galvanized steel, threaded.
- B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.4 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Conduit: Steel, galvanized tubing.
- B. Fittings: All steel, set screw, concrete tight. No push-on or indenter types permitted.
- C. Conduit Bodies: All steel threaded conduit bodies.

2.5 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: Steel, galvanized, spiral strip.
- B. Fittings and Conduit Bodies: All steel, galvanized, or malleable iron (except as allowed in specification 265113).

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: Flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

2.7 RIGID NONMETALLIC CONDUIT AND FITTINGS

- A. Conduit: Schedule 40 PVC minimum, Listed, sunlight resistant, rated for 90 °C conductors.
- B. Fittings and Conduit Bodies: NEMA TC 2, Listed.

2.8 CONDUIT SUPPORTS

- A. See Section 260529.

2.9 AUXILIARY GUTTERS (WIREWAYS)

- A. Description: Oil-tight and dust-tight type wireway without knockouts.
- B. Size: as required.
- C. Cover: Screw applied
- D. Connector: screw applied cover.

- E. Fittings: Lay-in type with removable top, bottom, and side; captive screws. Finish: Rust inhibiting primer coat with gray enamel finish.

2.10 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: Galvanized steel, with stamped knockouts.
- B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.
- C. Concrete Ceiling Boxes: Concrete type.
- D. Cast Boxes: Cast ferroalloy, or aluminum type deep type, gasketed cover, threaded hubs.

2.11 FLOOR BOXES

- A. Floor Boxes for Installation in Cast-In-Place Concrete Floors: Full adjustable.

2.12 PULL AND JUNCTION BOXES

- A. Pull boxes and junction boxes shall be minimum 4 inch square by 2-1/8 inches deep for use with 1 inch conduit and smaller. On conduit systems using 1-1/4 inch conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4-11/16 inch square.
- B. For telecommunication, fiber optic, security, and other low voltage cable installations the NEC box size requirements shall apply. All boxes, used on telecommunication, security, other low voltage and fiber optic systems with conduits of 1-1/4 inch and larger, shall be sized per the NEC conduit requirements. For determining box size, the conduit is the determining factor not the wire size.
- C. Sheet Metal Boxes: Code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.
- D. Sheet Metal Boxes Larger than 12 inches in any dimension shall have a hinged cover or a chain installed between box and cover.
- E. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron or aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- F. Fiberglass or Concrete Handholes with weatherproof cover of non-skid finish shall be used for underground installations.
- G. Box extensions and adjacent boxes within 48 inches of each other are not allowed for the purpose of creating more wire capacity.
- H. Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.
- I. Wireways shall not be used in lieu of junction boxes.

2.13 GENERAL

- A. All steel fittings and conduit bodies shall be galvanized.
- B. No cast metal or split-gland type fittings permitted.
- C. Mogul-type condulets larger than 2 inch not permitted except as approved or detailed.
- D. All conduit covers must be fastened to the conduit body with screws and be of the same manufacturer.
- E. Wireways, gutters and c-condulets shall not be used in lieu of pull boxes and condulets.
- F. All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

PART 3 EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. EMT is permitted to be used in sizes 4 inch and smaller for power and telecommunication systems. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.
- B. Size power conductor raceways for conductor type installed. Conduit size shall be 1/2 inch minimum except all homerun conduits shall be 3/4 inch, or as specified elsewhere. Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.
- C. Size conduit for all other wiring, including but not limited to data, control, security, fire alarm, telecommunications, signal, video, etc. shall be sized per number of conductors pulled and their cross-section. 40% fill shall be maximum for all new conduit fills.
- D. Arrange conduit to maintain headroom and present a neat appearance.
- E. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- F. Maintain minimum 6 inch clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- G. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.
- H. Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- I. Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.
- J. Support and fasten metal conduit at a maximum of 8 feet on center.
- K. Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, other conduits, etc., unless so approved or detailed.
- L. In general, all conduit shall be concealed except where noted on the drawings or approved by the Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except in mechanical rooms.
- M. Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.
- N. For indoor conduits, no continuous conduit run shall exceed 100 feet without a junction box.
- O. All conduits installed in exposed areas shall be installed with a box offset before entering box.

3.2 CONDUIT INSTALLATION

- A. Cut conduit square; de-burr cut ends.
- B. Conduit shall not be fastened to the corrugated metal roof deck.
- C. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- D. Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations.

- E. All conduit terminations (except for terminations into conduit bodies) shall use conduit hubs, or connectors with one locknut, or shall use double locknuts (one each side of box wall) and insulated bushing. Provide bushings for the ends of all conduit not terminated in box walls. Refer to Section 260526 – Grounding and Bonding for Electrical Systems for grounding bushing requirements.
- F. Install no more than the equivalent of three 90 degree bends between boxes.
- G. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch (50 mm) size unless sweep elbows are required.
- H. Conduit shall be bent according to manufacturer's recommendations. Torches or open flame shall not be used to aid in bend of PVC conduit.
- I. Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.
- J. Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.
- K. Install expansion-deflection joints where conduit crosses building expansion joints. Note: expansion-deflection joints are not required where conduit crosses building control joints if the control joint does not act as an expansion joint. Install expansion fitting in PVC conduit runs as recommended by the manufacturer.
- L. Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.
- M. Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers, unheated and heated spaces, buildings, etc., provide Listed conduit seals to prevent the passage of moisture and water vapor through the conduit.
- N. Route conduit through roof openings for piping and ductwork where possible.
- O. Conduit is not permitted in any slab topping of two inches or less.
- P. Ground and bond conduit under provisions of Section 260526.
- Q. Maximum Size Conduit in Slabs Above Grade: 3/4 inch. Do not route conduits to cross each other in slabs above grade.
- R. PVC conduit shall transition to galvanized rigid metal conduit before it enters a concrete pole base, foundation, wall (where exposed) or up through a concrete floor.
- S. Identify conduit under provisions of Section 260553.
- T. All conduit installed underground (exterior to building) shall be buried a minimum of 24 inches below finished grade, whether or not the conduit is concrete encased.
- U. PVC conduit shall be cleaned with solvent, and dried before application of glue. The temperature rating of glue/cement shall match weather condition. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The entire installation shall meet manufacturers recommendations.

3.3 CONDUIT INSTALLATION SCHEDULE

- A. Conduit other than that specified below for specific applications shall not be used.
- B. Underground Installations within Five Feet of Foundation Wall: Rigid steel conduit.
- C. Underground Installations More than Five Feet from Foundation Wall: Rigid steel conduit. Plastic-coated rigid steel conduit. Schedule 40 PVC conduit.
- D. Under Slab on Grade Installations: Schedule 40 PVC conduit.
- E. Exposed Outdoor Locations: Rigid steel conduit.

- F. Concealed in Concrete and Block Walls: Rigid steel conduit. Electrical metallic tubing. Schedule 40 PVC conduit.
- G. Within Concrete Slab: Rigid steel conduit. Schedule 40 PVC conduit.
- H. Wet Interior Locations: Rigid steel conduit, PVC coated rigid steel conduit.
- I. Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
- J. Exposed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
- K. Motor and equipment connections: Flexible PVC coated metal conduit (all locations). Minimum length shall be one foot; maximum length shall be three feet. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
- L. Light fixtures: Direct box or conduit connection for surface mounted and recessed fixtures. Flexible metal conduit from a J-box for recessed lay-in light fixtures. Conduit size shall be 3/8 inch minimum diameter and six foot maximum length. Conduit length shall allow movement of fixture for maintenance purposes.
- M. Medium Voltage Applications (Interior Locations): Rigid steel conduit.

3.4 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.
- D. Boxes shall not be fastened to the metal roof deck.
- E. It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.
- F. In case of any question or argument over the location of an outlet, the Contractor shall refer the matter to the Architect/Engineer and install outlet as instructed by the Architect/Engineer.
- G. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.
- H. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch by 24 inch access doors.
- I. Locate and install to maintain headroom and to present a neat appearance.
- J. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

3.5 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.
- B. Power:
 - 1. Recessed (1/4" maximum) outlet boxes in masonry, concrete or tile construction shall be minimum 4 inch square, with device rings. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.

- C. Low Voltage:
 - 1. Recessed (1/4" maximum) outlet boxes in masonry, concrete or tile construction shall be minimum 4-11/16 inch square, 2-1/8 inch deep. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.
- D. Provide knockout closures for unused openings.
- E. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches of box.
- F. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide non-metallic barriers to separate wiring of different voltage systems.
- G. Install boxes in walls without damaging wall insulation.
- H. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes. Devices mounted above a countertop shall be oriented horizontally.
- I. Ceiling outlets shall be 4 inch square, minimum 2-1/8 inch deep except that concrete boxes and plates will be approved where applicable. Position outlets to locate luminaires as shown on reflected ceiling plans.
- J. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- K. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- L. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- M. Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.
- N. Surface wall outlets shall be 4 inch square with raised covers for one and two gang requirements. For three gang or larger requirements, use gang boxes with non-overlapping covers.

3.6 FLOOR BOX INSTALLATION

- A. Set boxes level and flush with finish flooring material.

3.7 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install Owner approved access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.
- B. Support pull and junction boxes independent of conduit.

END OF SECTION

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SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SCOPE

A . The work under this section includes the products and execution requirements relating to labeling of power, lighting, general wiring, signal, fire alarm, and telecommunications wire and cabling. Further, this section includes labeling of all terminations and related sub-systems, including but not limited to nameplates, stenciling, wire and cable marker labeling of all backbone fiber optic (inter-building, tie & riser) cables, terminating equipment and labeling of inner duct (fiber optic). Included are the following topics:

1. PART 1 - GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Submittals.
2. PART 2 - PRODUCTS.
 - a. Materials.
3. PART 3 - EXECUTION.
 - a. General.
 - b. Junction and Pullbox Identification.
 - c. Power and Control Wire Identification.
 - d. Wiring Device Identification.
 - e. Nameplate Engraving.
 - f. Panelboard Directories.

1.2 RELATED WORK

- A . Applicable provisions of Bidding Requirements and Division 1 - General Requirements govern work under this section.
- B . Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- C . Section 260523 - Control-Voltage Electrical Power Cables.
- D . Division 27, for Communications Cable and Equipment.

1.3 SUBMITTALS

- A . Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B . Include schedule for nameplates and stenciling.
- C . Prior to installation, the Contractor shall provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used. Samples shall be mounted on 8-1/2" x 11" sheets annotated, explaining their purposed use.

PART 2 PRODUCTS

2.1 MATERIALS

- A . Labels: All labels shall be permanent, and machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS ARE ALLOWED. Exception: Back side of device plates and junction boxes may use handwritten, legible labeling on box covers, unless specifically prohibited by other specification sections.

- B . Cable label size shall be appropriate for the conductor or cable size(s), outlet faceplate layout and patch panel design. All labels shall be self-laminating, white/transparent vinyl and be wrapped around the cable or sheath. Labels for power conductors (600V and lower) shall be cloth-type. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.
- C . Nameplates: Engraved three layer laminated plastic, black letters on a white background. Emergency system (level 1 and level 2) shall use white letters on red background.
- D . Tape (phase identification only): Scotch #35 tape in appropriate colors for system voltage and phase.
- E . Adhesive type labels not permitted except for phase and wire identification. Machine generated adhesive labels shall be permitted for device plates, 4-11/16 inch and smaller junction boxes, fire alarm and control devices.

PART 3 EXECUTION

3.1 GENERAL

- A . Where mixed voltages are used in one building (e.g. 4160 volt, 480 volt, 208 volt) each switch, switchboard, junction box, equipment, etc., on each system must be labeled for voltage in addition to other requirements listed herein.
- B . All branch circuit and power panels must be identified with the same symbol used in circuit directory in main distribution center.
- C . Clean all surfaces before attaching labels with the label manufacturer’s recommended cleaning agent.
- D . Install all labels firmly as recommended by the label manufacturer.
- E . Labels shall be installed plumb and neatly on all equipment.
- F . Install nameplates parallel to equipment lines.
- G . Secure nameplates to equipment fronts using screws, rivets or manufacturer approved adhesive or cement.
- H . Embossed tape will not be permitted for any application.

3.2 JUNCTION AND PULLBOX IDENTIFICATION

- A . The following junction and pullboxes shall be identified utilizing spray painted covers:

System	Color(s)
Secondary Power – 480Y/277V	Brown
Secondary Power – 208Y/120V, 240/120V	White
Emergency Power – 480Y/277V	Brown/Red
Emergency Power – 208Y/120V	White/Red
Fire Alarm	Red
Temperature Control	Green
Door Control and Door Monitoring System	Orange
Sound and Intercom Systems	Blue
Video Surveillance System/MATV	Yellow

- B . Provide circuit numbers, and source panel designations for power wiring. Other system shall be identified as shown on details or approved shop drawings. Temperature control shall identify the source.

3.3 POWER AND CONTROL WIRE IDENTIFICATION

- A . Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.
- B . All wiring shall be labeled within 2 to 4 inches of terminations. Each end of a wire or cable shall be labeled as soon as it is terminated including wiring used for temporary purposes.

3.4 WIRING DEVICE IDENTIFICATION

- A . Wall switches, receptacles, occupancy sensors, wall dimmers, device plates and box covers, poke-through fittings, access floor boxes, photocells and time clocks shall be identified with circuit numbers and source. In exposed areas, identifications should be made inside of device covers, unless directed otherwise. Use machine-generated labels, or neatly hand-written permanent marker.

3.5 NAMEPLATE ENGRAVING

- A . Provide nameplates of minimum letter height as scheduled below.
- B . Panelboards, Switchboards and Motor Control Centers: 1 inch; identify equipment designation. 1/2 inch (13 mm); identify voltage rating, source and room location of the source.
- C . Equipment Enclosures: 1 inch; identify equipment designation.
- D . Circuit Breakers, Switches, and Motor Starters in Panelboards or Switchboards or Motor Control Centers: 1/2 inch; identify circuit and load served, including location.
- E . Individual Circuit Breakers, Disconnect Switches, Enclosed Switches, and Motor Starters: 1/2 inch; identify source and load served.
- F . Transformers: 1 inch; identify equipment designation. 1/2 inch; identify primary and secondary voltages, primary source, and secondary load and location.
- G . Junction boxes: 1 inch; identify system source(s) and load(s) served. Junction boxes may be neatly identified using a permanent marker.

3.6 PANELBOARD DIRECTORIES

- A . Typed directories for panels must be covered with clear plastic, have a metal frame. Room number on directories shall be Owner's numbers, not Plan numbers unless Owner so specifies.

END OF SECTION

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APP-5 Sample Work Permit Form.

APP-6 Copy of Warning Labels, including study date.

- E. The above sections shall include the following items in detail:
1. Obtain available fault current from the local utility company.
 2. Short circuit studies shall evaluate the available fault current at each bus (each change of impedance), including all three-phase motors.
 3. Coordination study recommendations for relay settings, breaker settings, and motor protection settings.
 4. Recommendations for improving the coordination and/or load distribution, as well as ground fault requirements.
 5. Arc flash values for two normal cases to define the highest values (low short circuit and high short circuit).
 6. Arc flash values for two maintenance cases, which define the arc flash values available at the equipment that would be available if the instantaneous trip of the upstream circuit breaker is set at a minimum value. This is recommended if someone has to work on live equipment.
 7. IEEE standard one-line diagram with equipment evaluation and circuit breaker setting forms that clearly define the system data and are easy to interpret.
 8. Recommendations to reduce the arc flash incident energy in all areas that require class 2 and higher PPE.
 9. Prioritized report summarizing all recommendations from this study. This shall include observed NEC code violations and their corrective action.
 10. The Contractor shall provide a one-line diagram that meets IEEE/ANSI standard 141, mounted on 24" x 36" (minimum) Styrofoam backboard. This one-line diagram shall be mounted in each electrical room.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 SHORT CIRCUIT AND COORDINATION STUDY

- A. The short circuit, coordination, and arc flash hazard studies shall be performed using SKM Dapper, Captor and PowerTool for Windows software packages. In the short circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, and recommendations. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault currents.
- B. In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

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SECTION 262200

LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SCOPE

- A. The work under this section includes dry type general purpose two winding transformers meeting the requirements of NEMA TP-1, and dry type isolation transformers. Included are the following topics:
 - 1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. References.
 - d. Submittals.
 - e. Operation and Maintenance Data.
 - f. Delivery, Storage, and Handling.
 - 2. PART 2 – PRODUCTS.
 - a. Dry Type General Purpose Two Winding Transformers.
 - 3. PART 3 – EXECUTION.
 - a. Installation.
 - b. Field Quality Control.

1.2 RELATED WORK

- A. Applicable provisions of Bidding Requirements and Division 1 - General Requirements govern work under this section.

1.3 REFERENCES

- A. NEMA TP-1.

1.4 SUBMITTALS

- A. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

1.5 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under applicable sections in Bidding Requirements and Division 1 - General Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect equipment in a dry location with uniform temperature. Cover ventilating openings to keep out dust.
- B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Square D: www.squared.com.
- B. Siemens: www.siemens.com.

- C. General Electric: www.geindustrial.com.
- D. Cutler Hammer: www.cutlerhammer.com.

2.2 DRY TYPE GENERAL PURPOSE TWO WINDING TRANSFORMERS

- A. Dry Type General Purpose Transformers: Factory assembled, air cooled, dry type general purpose two winding transformers per NEMA-TP1; ratings as shown on the Drawings.
- B. Transformers shall meet the energy efficiency standards of NEMA TP-1 and the DOE 'ENERGY STAR' label.
- C. Transformer losses shall conform to NEMA TP-1 requirements.
- D. Insulation system shall be rated at 220 degrees C.
- E. Winding temperature rise shall be rated at 150 degrees C above a 40 degrees C ambient.
- F. Case temperature shall not exceed 50 degrees C rise above a 40 degrees C ambient at its warmest point.
- G. Winding Taps, Transformers 15 KVA and Larger: Four 2-1/2 percent taps, two above and two below rated voltage, full capacity taps on primary winding.
- H. Sound Levels: Maximum sound levels are as follows:

<u>KVA</u>	<u>Sound</u>
<u>Rating</u>	<u>Level</u>
15-50	45 dB
51-150	50 dB
151-300	55 dB
301-500	60 dB
501-750	65 dB
- I. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap sized to meet NEMA and UL standards.
- J. Coil Conductors: Continuous windings with termination pads brazed or welded.
- K. Isolate core and coil from enclosure using vibration absorbing mounts.
- L. Enclosure: NEMA Type per drawings. Provide lifting eyes or brackets.
- M. Nameplate: Include transformer connection data.
- N. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor or trapeze mounting.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, 2 ft. minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- D. Provide sufficient space around transformer for cooling as recommended by the manufacturer.

3.2 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages and make appropriate tap adjustments within 2-1/2% of the normal operating load after the building is in full operation.

END OF SECTION

SECTION 262416

PANELBOARDS

PART 1 GENERAL

1.1 SCOPE

- A . The work under this section includes main, distribution and branch circuit panelboards. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Submittals.
 - d. Operation and Maintenance Data.
 - e. Spare Parts.
 2. PART 2 – PRODUCTS.
 - a. Main and Distribution Panelboards.
 - b. Branch Circuit Panelboards.
 3. PART 3 – EXECUTION.
 - a. Installation.
 - b. Field Quality Control.

1.2 RELATED WORK

- A . Applicable provisions of Division 1 govern work under this Section.

1.3 SUBMITTALS

- A . Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements for Submittal procedure.
- B . Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, and circuit breaker arrangement and sizes.

1.4 OPERATION AND MAINTENANCE DATA

- A . All operations and maintenance data shall comply with the submission and content requirements specified.

1.5 SPARE PARTS

- A . Keys: Furnish 2 keys for each panelboard to Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A . Square D: www.squared.com.
- B . Siemens: www.siemens.com.
- C . General Electric: www.geindustrial.com.
- D . Cutler Hammer: www.cutlerhammer.com.

2.2 MAIN AND DISTRIBUTION PANELBOARDS

- A . Panelboards: Circuit breaker type.
- B . Enclosure: NEMA Type 1.. Minimum cabinet size: 5-3/4 inches deep; 20 inches wide, with 5 inch minimum gutter space top and bottom. Constructed of galvanized code gauge steel.

- C . Provide cabinet front with hinged door with flush lock. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.
- D . Provide metal directory holders with clear plastic covers.
- E . Provide panelboards with copper bus (phase buses, bus fingers, etc., ratings as scheduled on Drawings. Provide ground bars in all panelboards. Neutral and ground bars can be dual rated ALCU9. All spaces shall have bus fully extended and drilled for the future installation of breakers.
- F . Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings.
- G . Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- H . Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will be approved.

2.3 BRANCH CIRCUIT PANELBOARDS

- A . Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.
- B . Enclosure: Type 1. Minimum cabinet size: 5-3/4 inches deep; 20 inches (508 mm) wide with 5 inch minimum gutter space top and bottom. Constructed of galvanized code gauge steel. Panel enclosure (back box) shall be of non-stamped type (without KO's) to avoid concentric break out problem.
- C . Provide surface cabinet front with concealed trim clamps, concealed hinge and flush cylinder lock all keyed alike. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.
- D . Provide metal directory holders with clear plastic covers.
- E . Provide panelboards with copper bus (phase buses, bus fingers, etc., ratings as scheduled on Drawings. Provide ground bars in all panelboards. Neutral and ground bars can be dual rated ALCU9. All spaces shall have bus fully extended and drilled for the future installation of breakers.
- F . Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings.
- G . Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers. Provide UL Class A ground fault interrupter circuit breakers where shown on Drawings. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- H . Do not use tandem circuit breakers.
- I . Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will be approved.

All of the panelboards provided under this section shall be by the same manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A . See Section 260529 for support requirements.
- B . Install panelboards plumb with wall finishes.
- C . Height: 6 feet to top.
- D . Install a crimp type stud termination to stranded conductor when terminating on circuit breakers without a captive assembly rated for terminating stranded conductors.

- E . Provide filler plates for unused spaces in panelboards.
- F . See Section 26 05 53 for identification requirements. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- G . Stub three (3) empty 3/4 inch conduits to accessible location above ceiling or below floor out of each recessed panelboard. Cap these conduits to prevent material from entering them.

3.2 FIELD QUALITY CONTROL

- A . If aluminum conductors size #1/0 and larger (per Section 26 05 19) are to be used as panelboard feeders, it is the responsibility of the Contractor to provide panelboards with adequate wire bending space to accommodate the aluminum conductors and terminators to meet allowable code requirements. The Contractor shall circuit the panelboards as shown on the drawings. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 10 percent, rearrange circuits in the panelboard to balance the phase loads within 10 percent.
- B . Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections.

END OF SECTION

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SECTION 262702

EQUIPMENT WIRING SYSTEMS

PART 1 GENERAL

1.1 SCOPE

- A . The work under this section includes electrical connections to equipment specified under other Divisions and/or Sections, or furnished by Owner, including, but not limited to:
 - 1. HVAC motors, VFDs, and panels.
 - 2. Plumbing motors, VFDs, and panels.
- B . Included are the following topics:
 - 1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Submittals.
 - d. Coordination.
 - 2. PART 2 – PRODUCTS.
 - a. Cords and Caps.
 - b. Other Products.
 - 3. PART 3 – EXECUTION.
 - a. Inspection.
 - b. Preparation.
 - c. Installation.
 - d. HVAC and Plumbing Connections.
 - e. Equipment Connection Schedule.

1.2 RELATED WORK

- A . Applicable provisions of Bidding Requirements and Division 1 - General Requirements govern work under this section.
 - 1. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
 - 2. Section 260533 - Raceway and Boxes for Electrical Systems.

1.3 SUBMITTALS

- A . Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B . Product Data: Provide data for cord and wiring devices.

1.4 COORDINATION

- A . Coordinate all equipment requirements with the various Contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required.

PART 2 PRODUCTS

2.1 CORDS AND CAPS

- A . Straight-blade Attachment Plug: NEMA WD 1.
- B . Locking-blade Attachment Plug: NEMA WD 5.
- C . Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- D . Cord Construction: Oil-resistant thermoset insulated multiconductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.

- E . Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

2.2 OTHER PRODUCTS

- A . Refer to related sections for other product requirements.

PART 3 EXECUTION

3.1 INSPECTION

- A . Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 PREPARATION

- A . Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.3 INSTALLATION

- A . Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.
- B . Make conduit connections to equipment using flexible PVC-coated metal conduit.
- C . Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
- D . Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
- E . Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.
- F . Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.
- G . Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

3.4 HVAC AND PLUMBING CONNECTIONS

- A . Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through starters, variable frequency drives (VFDs), and disconnects to motors or to packaged control panels. Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control panels and motors.
- B . VFD Installations: Install VFD input wiring and output wiring in separate conduit systems. Do not mix VFD input power and output power, or control wiring in a common raceway.
- C . Provide 120 volts to each temperature control panel. Coordinate requirements with HVAC/DDC Contractors.
- D . Unless otherwise specified, all electrical motors and control devices such as aquastats, float and pressure switches, fan powered VAV boxes, switches, electro-pneumatic switches, solenoid valves and damper motors requiring mechanical connections shall be furnished and installed and wired by the Contractor supplying the devices.
- E . Each motor terminal box shall be connected with a minimum 12 inch, maximum 36 inch piece of flexible PVC-coated metal conduit to a fixed junction box. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
- F . Check for proper rotation of each motor.

3.5 EQUIPMENT CONNECTION SCHEDULE

A . As indicated on the drawings.

END OF SECTION

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SECTION 262726

WIRING DEVICES

PART 1 GENERAL

1.1 SCOPE

- A. The work under this section includes wall switches, receptacles, occupancy sensors, wall dimmers, device plates and box covers, poke-through service fittings, access floor boxes, photo cells and time clocks. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Submittals.
 - d. Operation and Maintenance Data.
 2. PART 2 – PRODUCTS.
 - a. Manufacturers.
 - b. Wall Switches.
 - c. Receptacles.
 - d. Occupancy Sensors.
 - e. Wall Dimmers.
 - f. Device Plates and Box Covers.
 3. PART 3 – EXECUTION.
 - a. Installation.
 - b. Field Quality Control.
 - c. Occupancy Sensors.
 - d. Adjusting.

1.2 RELATED WORK

- A. Applicable provisions of Bidding Requirements and Division 1 - General Requirements govern work under this section.

1.3 SUBMITTALS

- A. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Provide product data showing model numbers, configurations, finishes, dimensions, and manufacturer's instructions.
- C. For occupancy sensor shop drawings, the manufacturer's actual layout of occupancy sensors and the wiring diagrams shall be provided.

1.4 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under applicable sections in Bidding Requirements and Division 1 - General Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Cooper: www.cooperwiringdevices.com.
- B. Hubbell: www.hubbell-wiring.com.
- C. Pass and Seymour: www.passandseymour.com.
- D. Leviton: www.leviton.com.

2.2 WALL SWITCHES

- A. Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: Heavy duty use toggle switch, rated 20 amperes and 120/277 volts AC. Switches shall be UL20 Listed and meet Federal Specification WS-896. All switches shall be heavy duty Specification Grade with separate green ground screw.
- B. All switches shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG. Switches shall be Leviton model 1221-S, Hubbell model CS1221, Pass & Seymour model CSB20, Cooper model CSB120, or approved equal.
 - 1. Handle: Made of nylon or high impact resistant material.
 - 2. Color: Gray.

2.3 RECEPTACLES

- A. Convenience and Straight-blade Receptacles: NEMA Type 5-20R, nylon or high impact resistant face. Receptacles shall be UL498 Listed and meet Federal Specification WC-596. All duplex receptacles shall be heavy duty Specification Grade, 20 amp rated. All receptacles shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Receptacles shall be Leviton model 5362, Hubbell model HBL5362, Pass & Seymour model 5362A, or Cooper model AH5362.
- B. Generally, all receptacles shall be duplex convenience type unless otherwise noted.
- C. All receptacles installed in outdoor locations, in garages, within 6 feet of the outside edge of sinks, and in other damp or wet locations shall be GFCI type.
- D. GFCI Receptacles: Duplex convenience receptacle, Specification Grade, with integral ground fault current interrupter meeting the requirements of UL standard 943 Class A and UL standard 498. GFCI receptacles shall be Leviton model 7899, Hubbell model GF20, Pass & Seymour model 2095, Cooper model VGF20 or approved equal.
- E. All devices shall be Gray in color. All receptacles on emergency circuits shall have a red face.
- F. All receptacles designated as isolated ground shall have an isolated ground triangle imprint on the face of the receptacle.
- G. Locking-Blade Receptacles: As indicated on drawings.
- H. Specific-use Receptacle Configuration: As indicated on drawings.

2.4 OCCUPANCY SENSORS

- A. All occupancy sensors shall be hardwired type; battery type shall not be permitted.
- B. Wall Mounted (Wall Switch Type):
 - 1. The sensor shall use either passive infrared or, if dual technology, passive infrared and passive acoustic sensing, or passive infrared and ultrasonic, for detecting room occupancy. The unit shall fit in/on a standard single gang switch box.
 - 2. Rated capacity: 600 watts minimum at 120 volts, 60 Hz; 1000 watts minimum at 277 volts, 60 Hz.
 - 3. Sensitivity shall be user adjustable or self-adjusting type.
 - 4. The delay timer shall be adjusted within a range of 6 to 30 minutes by the Contractor in the field. The sensor shall have a test mode for performance testing.
 - 5. The off switch shall have manual override for positive off and automatic on.
 - 6. The test LED shall indicate motion.
 - 7. The area of coverage shall be approximately 180 degrees by 35-40 feet.
 - 8. The unit shall have a five year warranty.

C. Ceiling Mounted:

1. The sensor shall use either passive infrared or, if dual technology, passive infrared and passive acoustic sensing, or passive infrared and ultrasonic, for detecting room occupancy. The unit shall fit in/on a standard octagon box. All ceiling mounted sensors shall be installed to a box with ring and box support.
2. Rated capacity shall be 20 amps at 120 or 277 volts, for fluorescent lamps. Provide power pack as required for low voltage sensors.
3. Sensitivity shall be user adjustable or self-adjusting type.
4. The delay timer shall be adjusted within a range of 6 to 30 minutes by the Contractor in the field. The sensor shall have a test mode for performance testing.
5. The coverage area shall be 360 degrees by approximately 15 feet radius when mounted at 9 foot height. The sensor shall have provisions, such as masking, to block out problem areas.
6. Test LED to indicate motion.
7. The unit shall have a five year warranty.
8. See drawings for actual type of sensor.

2.5 WALL DIMMERS

- A. Wall Dimmers: Linear slide semiconductor type.
- B. Rating: 600 Watts minimum, larger size to accommodate load shown on Contract Drawings.

2.6 DEVICE PLATES AND BOX COVERS

- A. Decorative Cover Plate: 302/304 smooth stainless steel.
- B. Weatherproof Cover Plate: Gasketed metal with hinged device covers.
- C. Surface Cover Plate: Raised galvanized steel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install wall switches 46 inches above floor to the center of device, OFF position down.
- B. Install wall dimmers 46 inches above floor to the center of device; de-rate ganged dimmers as instructed by manufacturer; do not use common neutral.
- C. Install convenience receptacles 24 inches above floor, 2" above backsplash, grounding pole on bottom.
- D. Install box for information outlet 24 inches above finished floor. Install box for telephone jack for wall telephone 48 above finished floor.
- E. Install specific-use receptacles at heights shown on Contract Drawings.
- F. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions.
- G. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- H. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- I. Install devices and wall plates flush and level.
- J. Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding receptacles using mounting screws as bonding means are not approved.

3.2 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch and sensor with circuit energized and verify proper operation.

- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.
- F. Owner personnel reserve the right to be present at all tests.

3.3 OCCUPANCY SENSORS

- A. Power packs used in return air plenum ceiling areas shall be installed in an approved enclosure or UL listed for return air plenum.
- B. Provide a minimum of 4 feet of coiled cable for ceiling-mounted sensors.
- C. Sensitivity Test: After the sensor has been energized for at least 15 minutes, walk to the middle of the room (if conference room) or sit at the normal desk position (if and office). Make no motion for 20 seconds. Move one arm up and down slowly. The test LED should blink.
- D. Time Delay Test: Set the time delay for 10 minutes. Walk into the room to activate the sensor then leave room. Sensor must turn lights off at approximately 10 minutes. Walk into the room again to reactivate the lights. Lights should activate within 1 second.
- E. For lights on emergency power without a remote transfer device, route the emergency circuit through a separate relay controlled by the occupancy sensor(s) in the respective area. For lights on emergency power with a remote transfer device, the emergency power does not get routed through the occupancy sensor relay, but the normal power does get routed through the occupancy sensor relay.

3.4 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Mark all conductors with the panel and circuit number serving the device with a machine generated label, at the device, and on the back of the device cover.

END OF SECTION

SECTION 262728

DISCONNECT SWITCHES

PART 1 GENERAL

1.1 SCOPE

- A . The work under this section includes disconnect switches, fuses and enclosures. Included are the following topics:
1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Submittals.
 - d. Operation and Maintenance Data.
 2. PART 2 – PRODUCTS.
 - a. Manufacturers.
 - b. Disconnect Switches.
 - c. Fuses.
 3. PART 3 – EXECUTION.
 - a. Installation.

1.2 RELATED WORK

- A . Applicable provisions of Bidding Requirements and Division 1 - General Requirements govern work under this section.

1.3 SUBMITTALS

- A . Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B . Include outline drawings with dimensions, and equipment ratings for voltage, ampacity, horsepower, and short circuit.

1.4 OPERATION AND MAINTENANCE DATA

- A . All operations and maintenance data shall comply with the submission and content requirements specified under applicable sections in Bidding Requirements and Division 1 - General Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A . Square D: www.squared.com.
- B . Siemens: www.siemens.com.
- C . General Electric: www.geindustrial.com.
- D . Cutler Hammer: www.cutlerhammer.com.

2.2 DISCONNECT SWITCHES

- A . Fusible Switch Assemblies (use only when overcurrent protection is required): NEMA Type Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class R cartridge type fuses.
- B . Nonfusible Switch Assemblies: NEMA Type Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C . Enclosure: NEMA Type 1 for interior installations and Type 3R for exterior installations.

D . Provide manufacturer's equipment ground kit in all disconnect switches.

2.3 FUSES

A . Fuses 600 Amperes and Less: Dual element, time delay, 600 volt, UL Class RK 5. Interrupting Rating: 200,000 rms amperes.

B . Fuses 601 Amperes and Larger: Time delay, 600 volt, UL Class L. Interrupting Rating: 200,000 rms amperes.

C . **Provide three (3) spares of each size and type fuse. Provide enclosure for spare fuse.**

PART 3 EXECUTION

3.1 INSTALLATION

A . Install disconnect switches where indicated on Drawings.

B . Provide identification as specified in Section 260553.

END OF SECTION

SECTION 265113

INTERIOR LIGHTING FIXTURES, LAMPS, AND BALLASTS

PART 1 GENERAL

1.1 SCOPE

- A. The work under this section includes interior luminaires and accessories, exit signs, lamps, and ballasts. Included are the following topics:
 - 1. PART 1 – GENERAL.
 - a. Scope.
 - b. Related Work.
 - c. Submittals.
 - d. Operation and Maintenance Data.
 - e. Extra Material.
 - 2. PART 2 – PRODUCTS.
 - a. Manufacturers.
 - b. Interior Luminaires and Accessories.
 - c. LED Luminaires.
 - 3. PART 3 – EXECUTION.
 - a. Installation.
 - b. Adjusting and Cleaning.
 - c. Interface with Other Products.
 - d. Field Quality Control.
 - e. All Fixture Connections Including Master-Satellite.

1.2 RELATED WORK

- A. Applicable provisions of Bidding Requirements and Division 1 - General Requirements govern work under this section.

1.3 SUBMITTALS

- A. Refer to applicable sections in Bidding Requirements and Division 1 - General Requirements.
- B. Include outline drawings, lamp and ballast data, support points, weights, accessory information and performance data for each luminaire type.
- C. For each luminaire type, submit luminaire information in the following example table format, and submit catalog cuts with highlighted catalog numbers and required accessories.

LUMINAIRE		BALLAST	LAMP	ANSI INPUT WATTS
Type	Manufacturer and Catalog No.	Manufacturer, Quantity per Fixture, and Catalog No.	Manufacturer, Quantity per Fixture, and Catalog No.	

1.4 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under applicable sections in Bidding Requirements and Division 1 - General Requirements.

1.5 EXTRA MATERIAL

- A. Provide ten (10) percent of each lamp type, but not less than one (1) of each type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. As specified on Light Fixture Schedule on drawings.

2.2 INTERIOR LUMINAIRES AND ACCESSORIES

- A. See the Lighting Fixture Schedule on the drawings, for type of fixtures and catalog numbers. Catalog numbers are shown on the drawings for quality and performance requirements only. Fixtures manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated fixtures, and meet the intent of the design.
- B. Where alternate fixtures to those specified are provided, notification of alternates are required prior to bid in accordance with Section 26 05 00. Full photometric drawings and a spreadsheet indicating the differences between the specified fixtures and alternate fixtures shall be provided as part of the pre-bid notification. The spreadsheet shall indicate all aspects of the alternate fixture that differ from the specified fixture, including, but not limited to the following:
 - 1. Physical Dimensions.
 - 2. Mounting Type.
 - 3. Fixture Ratings/Listings.
 - 4. Housing Materials/Construction.
 - 5. Lumen Output.
 - 6. Fixture Voltage.
 - 7. Fixture Wattage.
 - 8. Fixture Efficacy.
 - 9. CCT.
 - 10. CRI.
 - 11. Beam Angles/Distribution.
 - 12. Manufacturer Warranty.
 - 13. Emergency Power.
 - 14. Controls Requirements.
- C. Provide fluorescent fixtures with quick-connect disconnecting means, similar to Thomas & Betts Sta-Kon.

2.3 LED LUMINAIRES

- A. LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
 - 1. Minimum Light Output.
 - 2. Zonal Lumen Requirements.
 - 3. Minimum Luminaire Efficacy.
 - 4. Minimum CRI.
 - 5. L70 Lumen Maintenance.
 - 6. Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
 - 7. Additional requirements:
 - a. Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the plans. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).
 - b. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 5-step MacAdam Ellipse binning process.
 - c. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.

- d. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
 - e. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
 - f. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
 - g. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
 - h. Driver shall have a rated life of 50,000 hours, minimum.
 - i. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
 - j. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
 - k. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.
 - l. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).
 - m. LED driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
 - n. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
 - o. Luminaire shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
 - p. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
 - q. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
 - r. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
 - s. All luminaires shall be provided with knockouts for conduit connections.
 - t. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).
 - u. Provide all of the following data on submittals:
 - 1) Delivered lumens.
 - 2) Input watts.
 - 3) Efficacy.
 - 4) Color rendering index.
8. LED Luminaires used for Emergency Egress Lighting:
- a. The failure of one LED shall not affect the operation of the remaining LEDs.
9. Emergency LED Luminaire Compatibility with Inverters:
- a. Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.
10. Dimming:
- a. LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC) or Pulse Width Modulation (PWM) operation.
 - b. LED luminaires shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the Luminaire Schedule on the plans without visible flicker or "popcorn effect". "Popcorn effect" is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Heavy duty jack chain supports may be used where indicated on the fixture schedule. Provide pendant or chain length required to suspend luminaire at indicated height.
- C. Support luminaires larger than 2 x 4 foot size independent of ceiling framing.
- D. Locate ceiling luminaires as indicated on reflected ceiling plan.
- E. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- F. The Contractor shall install fixture supports as required. Fixture installations with fixtures supported only by insecure boxes will be rejected. It shall be the Contractor's responsibility to support all lighting fixtures adequately, providing extra steel work for the support of fixtures if required. Any components necessary for mounting fixtures shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.
- G. Exposed Grid Ceilings: Provide auxiliary members spanning ceiling Ts to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips. Provide independent support for all fixtures over 50 lbs.
- H. Install recessed luminaires to permit removal from below.
- I. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- J. Install code required hardware to secure recessed grid-supported luminaires in place.
- K. Install wall mounted luminaires and exit signs at height as scheduled.
- L. Install accessories furnished with each luminaire.
- M. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- N. Bond fixtures and metal accessories to branch circuit equipment grounding conductor.
- O. Install specified lamps in each luminaire and exit sign.
- P. HID Luminaires: Use power hook hangers rated 500 pounds minimum or provide safety chain between ballast and structure. Provide safety chain between reflector and ballast.
- Q. All lamps shall be delivered to the job in sealed cartons and protected from dirt and dust during storage on the project. Lamps shall be taken directly from the cartons and installed in the fixture with special care so that they do not become dusty and are not soiled in the operation.
- R. Lamps installed in fixtures using dimming ballasts shall be burned in at 100% rated output by the Contractor for a minimum of 100 hours as recommended by the ballast manufacturer.
- S. All new lamps shall be operational at the Substantial Completion of the project.

3.2 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Aim and adjust luminaires as indicated on Drawings or as directed by the Architect/Engineer.
- C. Touch up luminaire finish at completion of work.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Interface with air handling accessories furnished and installed under Division 23.

3.4 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.5 ALL FIXTURE CONNECTIONS INCLUDING MASTER-SATELLITE

- A. Direct box or conduit connections for surface and recessed fixtures. Flexible metal conduit from a J-box for recessed lay-in light fixtures. Flexible metal conduit shall be minimum 3/8" minimum diameter and six foot maximum length. Flexible whip between master and slave fixtures may be supported off of the ceiling grid wires. Conduit length shall allow movement of the fixture for maintenance purposes. Minimum wire size shall be #18 AWG for single fixture or master-slave fixture.
- B. The flexible connectors shall be all steel, galvanized, clamp type with locknut or snap-in connector including those used on the master-slave unit.

END OF SECTION